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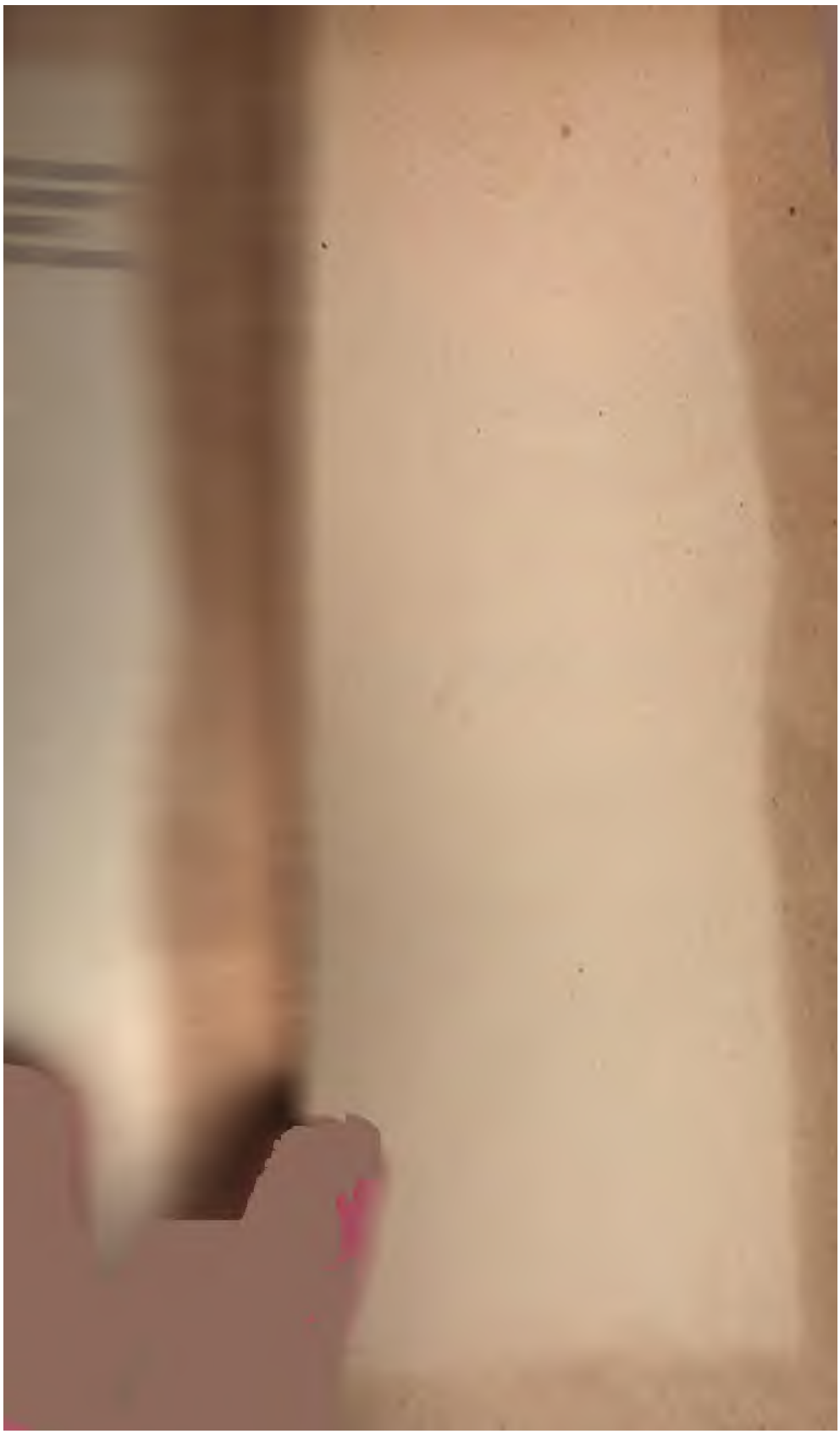

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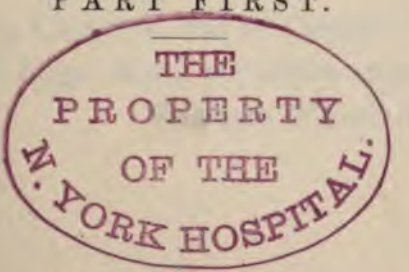

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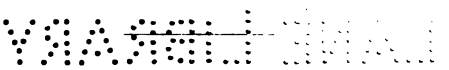

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PREFACE.

THE Editors of the second volume of the present edition are as follows:—

Of the Chapters RELATIVE TO THE FŒTUS AND NEW-BORN CHILD, AND TO THE DIFFERENCE OF SEX:

SAMUEL ASHHURST, M.D., of Philadelphia;

Of the Chapters on POISONS:

ROBERT AMORY, M.D., of Brookline, Massachusetts;

Of the Chapters on WOUNDS AND SIGNS OF DEATH:

WHARTON SINKLER, M.D., of Philadelphia;

Of the remaining Chapters, and of Certain Psychological and Legal Notes elsewhere appearing:

FRANCIS WHARTON, LL.D.

May 1, 1873.

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CORRIGENDA.

Page 239, third line from top, *after* "rape," *insert* "if the intention was to use force, on fraud failing."

Page 241, note (*c*), *for* "211 Stark." *read* "2 Stark.;" and *before* "C. & P." *insert* "5."

Page 994, note (*e*), *read* "Washington" *for* "Washburn."

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CHAPTER I.

SINGS OF PREGNANCY.

§ 1. SIGNS of pregnancy may be divided into the certain and uncertain. Until the period at which the pulsation of the fœtal heart becomes audible there is not one sign, nor indeed any combination of signs, which will not occasionally prove treacherous. Some practitioners are in the habit of relying upon signs which by others are considered of trivial or doubtful significance. It may be remarked, moreover, that evidence of pregnancy which would be quite convincing to a practitioner of midwifery, may not be so readily accepted by a medical jurist. The latter naturally lays greater stress, by far, upon exceptional cases. In this view, we class among the uncertain signs of pregnancy suppression of the menses, enlargement of the abdomen, quickening, and the sympathetic phenomena.

§ 2. 1st. *Suppression of the menses.*—When the catamenia are arrested in a woman previously regular, and the suppression is not followed by any morbid symptoms, this sign is usually considered quite a positive one. The exceptions that may be taken to it depend upon the great irregularity and frequent abnormal conditions of this function. Thus, pregnancy may occur in women who have never menstruated. Dr. Gregory, of Missouri, relates the case of a woman who had six living children, and had never menstruated. M. Gillette communicated to the Société d'Emulation de Paris, the case of a woman who had borne three children, was thirty-five years of age, but had never menstruated or had any vicarious discharge. Other cases are referred to in the *Am. Journ. of Med. Sci.* for April, 1844. Many similar ones are cited by Dr. Reid, from Baudelocque, Lamotte, Velpeau, Bull, and others;(*a*)

(*a*) Lancet, Sept. 1853, p. 206.

and the number is still further increased by those collected or reported by Montgomery.(*b*) The same authors also mention not a few examples of pregnancy occurring in women who for one or more years have ceased to menstruate.(*c*) The temporary absence of the menses is, moreover, not always an obstacle to impregnation, and in some cases, which are perfectly well authenticated, they were perceived only during the pregnant condition. Baudelocque and Deventer state that they have observed instances of this kind. A still more remarkable abnormality has been witnessed in some women, who have menstruated for the first time subsequent to impregnation. Cases also are occasionally met with in which the menstrual flux, or a discharge which cannot easily be distinguished from it, occurs at the usual periods during pregnancy as well as before it, and instances are not at all infrequent in which the menses return during the early months, only in smaller quantity than usual, and for a shorter time. Burton, Maunsell, Campbell, and others mention cases in which they appeared three, four, and six times; similar instances fell under the observation of Dr. Tyler Smith;(*d*) and Dr. Gibb has reported one in which menstruation continued during eighteen months of lactation, and nearly nine months of the pregnancy which then took place.(*e*) On the other hand, the catamenia may be suppressed from various causes, and sometimes with no immediate bad consequences. Hence, although, as a general rule, suppression of the menses is the earliest indication of the existence of pregnancy, it cannot be relied upon as at all positive in its nature.

§ 3. 2d. *Enlargement of the abdomen, etc.*—In pregnancy, the prominence of the abdomen generally becomes obvious about the end of the third month; and, from this time, the period of pregnancy can be ascertained in an approximate manner by the gradual ascent of the womb. Nothing, however, can

(*b*) Signs and Symptoms of Pregnancy, 2d ed. p. 77.

(*c*) A recent American case is that of Dr. Gibbs, N. Am. Med. and Surg. Journal, i. 741.

(*d*) Lancet, Feb. 1856, p. 197.

(*e*) Ibid., Nov. 1858, p. 475. *Vide* case by Dr. Grailly Hewitt, Transactions of the Obstetrical Society, vol. viii.

be more erroneous than to consider a prominent abdomen a proof of pregnancy. It may be due to dropsy, to a distended urinary bladder, or to various kinds of tumors of the ovaries or uterus, or to enlargement of the spleen or liver, or to the accumulations of flatus or of feces, and it may also arise from a retention of the menstrual discharge. So far from being a good sign of pregnancy, it should not be taken into consideration until a fair presumption is first established by other evidence. The sad story of Lady Flora Hastings, who was prematurely hurried to the grave by the brutal calumnies which the alteration in her shape, from disease, had given rise to, may serve as a caution to those who are over-hasty in their opinions.

§ 4. Enlargement of the abdomen, even independently of any solid tumor, in many cases simulates the distended uterus so exactly, and is so often associated with other signs of pregnancy, and particularly with the sensations of a moving body within the abdomen, as to deceive not only the patient, but even the experienced physician. It would scarcely be believed, were it not fully authenticated, that the Cæsarean section has been performed to remove the fœtus in such cases which were mistaken for examples of ovarian pregnancy. Five of them are referred to by Montgomery,(*f*) and Dr. Simpson states that six are recorded in which when the abdomen was opened nothing unusual or abnormal was discovered except a slight degree of distension of the bowels.(*g*) Usually, and when, as is most common, the distension of the abdomen arises from intestinal flatus and persistent tonic contraction of the muscles about the waist, simple percussion of the abdomen by producing a resonant sound shows that the enlargement cannot be due to the distended uterus; but sometimes a large amount of fat under the integuments may deaden the percussion sound, or an exaggerated sensibility of the skin may forbid this method of examination. In all such cases a solution of the problem is readily obtained by means of the anæsthetic agents. As soon as complete insensibility is induced by ether or chlo-

(*f*) Signs and Symptoms of Pregnancy, 2d ed. p. 405.
(*g*) Times and Gaz., Sept. 1859, p. 225.

roform, the protuberant abdomen subsides, and the delusion is exposed. With returning consciousness, however, the swelling reappears.(*h*)

§ 5. According to the observations of Elsässer,(*i*) the *brown discoloration of the linea alba* was found in 377 out of 400 pregnant women, extending from the sternum to the mons veneris, in 22 only in the lower half of the abdomen, and in 1 only in the upper. At the same time, however, this author observed other women in a pregnant condition in whom no trace of this discoloration could be perceived, and still others, not pregnant, in whom it was found; so that, although it is no doubt present in the majority of instances, there can be no safety in relying upon it as a sign of pregnancy. Tanner utterly denies that brown discoloration of the abdomen possesses any significance whatever as a sign of pregnancy.(*i*[1]) These conclusions agree with those which were earlier reached by Mr. Furner and Dr. Cormack, the latter of whom also found the dark abdominal line occasionally in males affected with disorders of the intestines or of the urinary organs.(*j*) *Prominence of the umbilicus* is sometimes spoken of as a sign of pregnancy, but it does not occur until the abdomen is considerably distended by the uterus, at which time certain evidence of the presence of a fœtus is ascertainable by other means.

§ 6. 3d. *Changes in the mouth and neck of the womb.*—These changes vary, according as they are observed in those who have had children and in those who have never before been pregnant. We do not propose to describe them at length.(*k*) It is here sufficient to remark, in general, that the uterus sinks somewhat lower in the pelvis in the early months, and thus the *os tincæ* is brought nearer to the entrance of the vagina, and is at the same time tilted somewhat backward. This gives rise to the idea that the *cervix* is lengthened, which is

(*h*) For several cases of Spurious Pregnancy, see Times and Gaz., Oct. 1855, p. 342.

(*i*) Henke's Zeitschrift, 1852, 4 H.

(*i*[1]) Signs and Diseases of Pregnancy, 2d ed., Phila., 1868, p. 96.

(*j*) Month. Journ. of Med. Sci., Feb. 1844.

(*k*) For a good description, see Montgomery on the Signs of Pregnancy, 2d ed. p. 183.

not the case. It does not undergo any change in length until after the fifth month, when it becomes gradually shorter and broader (being merged into the body of the womb), until the close of gestation, at which time it is found to be entirely obliterated. The signs from the neck and mouth of the womb previous to the sixth month, are not to be greatly depended upon. Dr. J. Matthews Duncan states that the cervix does not undergo shortening at any time during pregnancy, or at least before the few concluding days, at which time it becomes entirely obliterated. In this view Tanner and J. Taylor, with other authorities, now coincide.(*a*)

§ 7. 4th. *Quickening* is defined by Dr. Evory Kennedy to be "a sense by the mother of the first perceptible motion in the uterine region, about the sixteenth week after impregnation, having for its cause either change of position of the uterus, or the motions of the fœtus," or, what is more probable, its first coming in contact with the walls of the uterus. It is frequently attended by fainting and weakness, and sometimes by a discharge of blood. Quickening occurs at no fixed period in the course of gestation. It usually is perceived at the time stated above, but occasionally earlier, and sometimes not until later. Occasionally, also, the sensation is not experienced. On the other hand, nothing is more common than for women to suppose that they quickened, when they are not even pregnant. Dr. Kennedy says: "I have known women to insist upon their having felt the child moving or kicking within them, not only in cases where there was indubitable proof of the child's death at the time, but also, as mentioned in the case or quickening, where no child was in the uterus."(*b*) Queen Mary, of England, distinctly felt the "babe leap in her womb' when the Pope's legate was introduced to her, although dropsy was the sole result. Klein(*c*) reports the case of a lady who *supposed* herself pregnant, and that she felt the motions of the child, and who at the proper period was seized with the pains of labor. A case is reported by Dr. Heming, in the *Lancet*, in

(*a*) Edin. Med. Journ., March, 1859, p. 773; American Med. Times, June 21, 1862.

(*b*) Obstet. Auscult. p. 26. (*c*) Hufeland's Journal, 1815, p. 65.

which physician and patient were both deceived. He was called to see the wife of a respectable tradesman; she was in labor, it was said, and the physician in attendance had been with her two days and nights. This gentleman told Dr. H. that he had felt the head of the child at first, but could not then say what part was presenting. An examination was made, and the woman found to be not even pregnant. She said that she had thought herself pregnant, because her stomach and bosom had lately become greatly enlarged, and because she had frequently felt the movements of the child, and had been irregular in her monthly periods.

§ 8. Some of the most experienced and competent judges have fallen into the error of supposing that they felt these movements in women who were not pregnant at all.(*d*) In these cases the error has probably arisen from mistaking for uterine contractions, those of the abdominal muscles. Dubois mentions a woman on whom the *toucher* was practised, and who possessed the power of imitating these movements at will. In other cases the contractile movements of the uterus distended by a dead fœtus, or by any other body, have led to the same erroneous conclusion; and in others, again, intestinal movements excited by flatus have deceived both patient and physician.

§ 9. The sensation which has received the name of quickening is not always equally well marked in its character; sometimes it is attended with fainting, weakness, and a general commotion of the system, while at others it resolves itself into an indistinct perception of the first feeble movements of the child. These have received from the French the name of *pattes d'araignées*. By some, the sensation is supposed to be due to these movements; by others, it is attributed to the sudden rising of the womb from the pelvis. To which of these causes it is really due, we shall not venture to decide, considering the reasons for either inconclusive. The fact which, above all others, is of importance, is, that the sign is strictly a *subjective* one. It is perceptible by the woman alone, and her veracity must therefore determine our acceptance of it.

(*d*) Dewees's Essays, p. 337; Dub. Med. Journ., vol. vi. p. 356.

In midwifery practice, the statement of the female is not called in question, unless her physician have suspicion that she may have been mistaken in her sensations; in legal medicine, however, the medical examiner should first convince himself by a direct examination of the probable existence of pregnancy, before questioning the woman, since it is evident that her assertions may be influenced by various considerations of interest and advantage. The examination will enable him to determine whether there is a fœtus in the womb, and whether it be living or dead, as well as to fix the probable period of pregnancy. Unless her statements corroborate the results of this physical examination, they may, if these results are positive, be entirely disregarded. Hence, the fact of quickening may be looked upon as a superfluous sign of pregnancy, having no value, except when sustained by other clear evidence of the existence of this condition.

§ 10. The undue importance attached to quickening, from the earliest times, arose from an error which modern science would long since have consigned to oblivion, had it not been fatally incorporated into the laws of various countries. It was supposed that the fœtus became endowed with vitality at a variable epoch after conception, and that quickening was an indication of the moment at which it became thus animated. Such an error, explicable in the infancy of physiological science, by an inadequate knowledge of the development of the embryo, confirmed by absurd ecclesiastical canons, and handed down from one criminal code to another, should now, when ignorance is no longer excusable, disappear from our penal system. To whatever cause the act of quickening may be attributed, its explanation is not dependent upon a solution of the question relative to the precise moment at which the child becomes endowed with life. If it be due to the first motions of the child perceptible to the mother, it is merely an indication of the strength of its *muscular movements;* and, if it is caused by the sudden rising of the uterus from the pelvis, it evidently has a still more distant connection with the phenomena of life. No serious argument is required to prove that the fœtus, in its embryonic condition, is a new being, living by its connection with its mother, and dying when this is destroyed. However

rudimentary its form, it is not an inorganic body, constituted by the casual aggregation of atoms, but a living creature, from whose undeveloped lineaments a perfect human shape is to be evolved. A pulsating heart, and a nervous tract, are among its earliest recognizable elements. Reason and observation equally declare its essential original vitality.

§ 11. The following remarks, by Prof. Hodge, forcibly illustrate these truths:—

"In a most mysterious manner brought into existence, how wonderful its formation! Imperfect in the first instance, yea, even invisible to the naked eye, the embryo is nevertheless endowed, at once, with the principles of vitality; and, although retained in the system of its mother, it has, in a strict sense, an independent existence. It immediately manifests all the phenomena of *organic* life; it forms its own fluids and circulates them; it is nourished and developed; and, very rapidly, from being a *rudis indigestaque moles*, apparently, an inorganic drop of fluid, its organs are generated and its form perfected. It daily gains strength and grows; and, while still within the organ of its mother, manifests some of the phenomena of animal life, especially as regards mobility. After the fourth month its motions are perceptible to the mother, and in a short period can be perceived by other individuals on due investigation.

"The usual impression, and one which is probably still maintained by the mass of the community, is that the embryo is perfected at the period of quickening—say the one hundred and twelfth or one hundred and twentieth day. When the mother first perceives motion, is, considered the period when the fœtus becomes animated—when it receives its spiritual nature into union with its corporeal.

"These and similar suppositions are, as has been already shown, contrary to all fact, to analogy, to reason, and, if it were not for the high authorities—medical, legal, and theological—in opposition, we might add, to common sense.

"What, it may be asked, have the sensations of the mother to do with the vitality of the child? Is it not alive because the mother does not feel it? Every practitioner of obstetrics can bear witness that children live and move and thrive long

before the mother is conscious of their existence; and that women have carried healthy living children to the seventh, and even to the ninth month, without being conscious of their motions. Moreover, how can a fœtus be termed *inanimate* when it grows, of course is nourished, and manifests all the phenomena of life? The supposition of inanimate embryos capable of being developed is, at the present day, an absurdity. From the moment of conception it must be alive, for immediately it begins to be developed; it is separated from the ovary, where it was generated, and travels some three or four inches, through a narrow tube or canal, to the uterus, as much disconnected from the mother as the chick in ovo is separated from the parent hen. Its subsequent attachments to the mother, by means of the placenta and uterus, are so indirect (as will be hereafter demonstrated) that we will be justified in asserting that the mother has little more influence upon the child in utero than the parent bird has upon its offspring in the egg.

"If the question, therefore, be returned upon us, When does that mystical union between our corporeal and spiritual nature, between matter and spirit, body and soul, occur? we answer, at the time of *conception*. It is then, only, the father can, in any way, exert an influence over his offspring; it is then, only, the female germ is in direct union with the mother—the connection afterwards is indirect and imperfect. To suppose that the body only is generated at conception, and that the spirit is subsequently added, is, in the absence of all direct revelation on the subject, philosophically untrue—being at variance with the facts and with reason, as has already been illustrated and enforced."

§ 12. 5th. *Sympathetic phenomena.*—Pregnant women display various consensual symptoms, which, when confirmed by other signs, compared with their sensations in previous pregnancies, or with their usual health in the unimpregnated condition, are not without considerable weight in determining the existence of pregnancy. But there is nothing more variable than these symptoms. Some women go through the whole of their pregnancy without being affected with morning sickness, salivation, dyspepsia, longings, disgusts, etc.; while others are hardly

ever free from some of these annoyances. Further, they may be easily feigned, where the female is desirous to persuade herself or to deceive others.

§ 13. A change in the *condition of the breasts* is of more importance. They become larger and firmer, knotty, and somewhat tender to the touch, and large blue veins may be seen meandering over the surface; the nipple and the follicles around it become more prominent, and the areola wider and of a dark-brown color. In some females the projection of the nipples and the enlargement of the breasts may be more or less hindered by corsets. The increase in the size of the breasts, being due mainly to the *secretion of milk*, does not, as a general rule, occur until the later periods of pregnancy, and sometimes not until delivery takes place. Occasionally, also, certain diseases of the uterus and ovaries will cause a tumefaction of the breasts. Retention of the menses from an imperforate hymen, fibrous tumors of the uterus, and ulceration of the mouth and neck of the uterus, are frequently, says Dr. T. Smith, concerned in these mammary changes; and habitual and excessive copulation sometimes has the same effect. The presence of milk in the breasts is of value, as a sign, only in cases where a woman never before pregnant, and menstruating regularly, has the catamenia suppressed.(*e*)

(*e*) For a large number of curious instances of the secretion of milk in women beyond the age of child-bearing, and in others where it was developed under extraordinary circumstances, *vide* Beck's Med. Journ., vol. i. p. 220. Also Dr. Dunglison's case of a man fifty-five years of age, who performed the office of wet-nurse for several years (Physiol., p. 833). Dr. Battersby gives an instance of a male child, three weeks old, from whom a drachm of milk could be drawn by pressure from the breasts. Analyzed by Mr. Moore, under the microscope, it was found to be a genuine lacteal secretion (Dublin Med. Press, April, 1850). See also Guillot's observations, Ed. Month. Journ., Feb. 1854, p. 165. A most interesting case is of recent occurrence. A woman fifty-five years of age, whose catamenia had ceased for many years, and who was also in bad health, undertook to bring up an infant whose mother had died in childbed. To keep it quiet, she was in the habit of putting it to her breast. At the end of six months she was surprised to find that the child was really drawing milk from her breasts. All other nourishment was suspended, and the child, which before had been weakly, soon became hearty and vigorous entirely upon the milk which he drew from her. She continued to nurse him for twelve months, at which time she weaned him. (E. Warren, M.D., Edenton, N. Car., in Va. Med. and S. Journ., 1854.)

§ 14. The changes taking place in the *areola* are considered, by Dr. Montgomery and some other eminent authorities, to afford very valuable evidence of pregnancy. The essential characters of the true areola resulting from pregnancy, are described to be a circle around the nipple, whose color varies in intensity according to the complexion, being generally much darker in persons with black hair, dark eyes, and sallow skin, than in those of fair hair, light-colored eyes, and delicate complexion. It becomes darker in color, but mottled, and wider as pregnancy advances. The skin over it is moist, and the follicles become prominent. These phenomena, in a woman not previously pregnant, when found in connection with other reliable signs of pregnancy, may confirm the inference made from them. Viewed singly, the changes in the areola will be found to be far from constant in their appearance. The complexion of the female has a good deal to do with their production; and, as Dr. Kennedy remarks, "we will often observe them very distinctly marked in virgins of a dark appearance, whilst in pregnant women of fair complexion no trace of them will be visible, even when they are advanced in this state. Again, where they have once been well marked, in consequence of one or more pregnancies, they seldom or never disappear entirely; and on this account, in cases of married women, they must be acknowledged as a test far from positive in its nature." Dr. Reid(*f*) observed them in a woman not pregnant but suffering from a chronic tumor of the left breast, and found that none of them were present in a woman who was soon after delivered of a living child. They are also known to occur in a variety of uterine affections. Siebold says that they may occur independently of pregnancy, and in cases of disease of the womb; and Dubois, that they may follow a suppression of menses, whatever its cause. Dr. Simpson, of Edinburgh, in a case of spurious pregnancy under his own care, observed that the areolæ became dark and their glandulæ enlarged. This was so marked, that a drawing of them was made about the third month. These sketches presented all the usual changes as distinctly as those figured by

(*f*) Lancet, Dec. 1838.

Dr. Montgomery in his plate of the true areola at that period; and, being preserved, they were found, on comparison, as marked as those of the patient's own breasts were at the same date, a short time after, when actual pregnancy supervened.(*g*)

Dr. Routh(*g*[1]) maintains, that, while in the case of fibroid tumors of the womb the areolæ undergo changes, they yet differ very materially in appearance from the changes which occur in pregnancy. The differences as laid down by Dr. Routh principally concern the follicles, and his conclusions may be thus tabulated:—

Pregnancy.	*Fibroids.*
1. The development is alike on both sides.	1. The breasts and follicles are unsymmetrical.
2. Follicles are white, especially when the skin is tightened.	2. Follicles have the same color as the areolæ.
3. True white follicles are present.	3. True vesicular or papuloid follicles, white in color, do not occur.
4. Follicles most numerous on the border of the areola.	4. Follicles most numerous on and near the nipple.
5. Peculiar white honey-comb layer external to the dark areola is present.	5. No white layer on the areola.
6. Cardiac sounds impreceptible.	6. Cardiac sounds can be heard by auscultation of the tumor.
7. Umbilicus prominent.	7. Umbilicus puckered.

§ 15. Earle(*g*[2]) contends that too little attention is paid to the condition of the breasts, which he thinks always present early and reliable signs of pregnancy. We have thought it well to epitomize his directions and conclusions as follows:—

1. Both breasts should be examined. 2. Enlargement to the eye is deceptive, but hypertrophy of the gland proper, perceptible to the touch, is a quite valuable sign. 3. Enlargement of the veins is important in accordance with its amount, while if they traverse the areolæ they are characteristic. 4. White streaks in the skin (cicatricial) evidence either prior or present pregnancy, and in general are readily distinguishable. 5. Increased diameter of the areolæ is a very important sign in women pregnant for the first time. 6. Intensified

(*g*) Edinb. Monthly Journ., July, 1853.
(*g*[1]) Brit. Med. Journ., 1864, i. 181.
(*g*[2]) Lond. Med. Review, February, March, and April, 1862.

color of the areolæ is of most importance in primiparæ, and in the latter months of gestation. 7. Elevation of the areola above the surrounding skin is most frequently found in the primiparous woman, and when found may be regarded as characteristic of pregnancy. 8. A shiny mahogany-colored areola is a very valuable indication, and, 9, secondary areola, occurring most frequently in primiparæ, is conclusive. 10. The presence of branny scales has some value, which is much increased if any fluid can be expressed from the nipple. 11. The presence of sebaceous follicles is conclusive, and is the most important of the mammary signs in the early months of multiparous women, while, 12, a raised areola and the presence of milk possess the highest value in the case of a woman carrying her first child. 13. The age of the fœtus cannot be arrived at by an examination of the breasts. Five kinds of follicles are enumerated by the author as existing in the areola, three of which, containing subaceous material, present evidence of pregnancy.

§ 16. A bluish or dusky color of the vagina, produced by venous congestion, was originally declared by Jacquemin to be an almost certain sign of pregnancy in females who are not subject to hemorrhoids. This statement has been confirmed by Kluge, Parent-Duchâtelet, Kilian, Wistrand, and Montgomery, the last of whom says, "In every instance, without a single exception, in which I have found this appearance distinctly marked, pregnancy coexisted."(*h*) It should, however, be remembered that pregnancy may exist, although this sign may not be visible.

§ 17. A very high authority, Dr. Robert Barnes,(*h*[1]) says that a reliable sign of pregnancy in the early months is a flattening of the upper wall of the vagina, which is caused by enlargement of the womb with anteversion, which carries the os backwards and necessarily makes the superior wall of the vagina tense.

§ 18. The more or less distinct presence of several phenomena, which have been now considered, independently of

(*h*) Signs and Symptoms of Pregnancy, 2d ed. p. 245.
(*h*[1]) Brit. Med. Journ., 1868.

the existence of any product of conception, characterizes the cases known as those of *spurious pregnancy*. They might be expected to be met with most frequently in women who have never borne children, and are, therefore, unacquainted with the sensations and conditions peculiar to pregnancy. But such is not the case. The most numerous examples of this delusion are presented by mothers approaching the period when the menses cease, and which is usually marked by uterine disorders of various kinds. Yet many are met with in the first year after marriage; and in such the source of the delusion is an instinctive longing for becoming a mother. To this powerful instinct must be attributed the occurrence of many phenomena of pregnancy in unmarried and pure women, associated with evidences of a hysterical or a highly nervous temperament, and the periodical *æstus* which often precedes and accompanies the catamenia. It is impossible to determine accurately whether the delusion has a mental or a physical origin, or in what degree either cause predominates; but it is probable that a state of excitement of the reproductive organs occasions impressions, if not sensations, which awaken corresponding ideas in the mind, and that these in their turn render the various physical phenomena more intense. The vivid descriptions of their sensations, therefore, given by the subjects of these various cases, are not necessarily to be taxed as inventions, nor are the physical phenomena which they display to be regarded always as cunning tricks intended to deceive. They represent convictions as profound and distinct as those of the monomaniac, and are often as difficult to eradicate.

§ 18*a*. All of the signs which have now been referred to are uncertain in their nature, and various objections may be urged against each of them, but, if a majority of the more important exist, the presumption of pregnancy is necessarily very strong, although *certainty* cannot be obtainable from them. The same objection cannot be made against the signs which we have designated as *certain*, from the fact that when found they indicate the presence of a fœtus infallibly; although it cannot, indeed, always be inferred from their *absence* that pregnancy does not exist. This class of signs demonstrates, therefore, the presence of a fœtus in the womb, and are ob-

tained by physical methods of exploration, inspection, touch, auscultation, etc.

§ 18*b*. The *passive movements* of the child are obtained by the manœuvre termed *ballottement* by the French. The female being in a standing posture, the finger is introduced into the vagina, up to the mouth of the uterus, while the other hand is placed upon the abdomen. The womb is suddenly raised up by an abrupt movement of the finger, and, falling again upon it with a slight shock, communicates the sensation of sudden displacement of a body contained in a liquid. This test is seldom applicable before the fifth month, and sometimes not after the eighth, owing either to the position of the child or the small amount of amniotic fluid present. In competent hands the test is a safe one; but it can give evidence only of the presence of a fœtus—whether this be living or dead must be ascertained by other means. Another mode of performing ballottement, but which is inferior to that just described, consists in giving sudden movements to the uterus by the hand, placed upon opposite sides of the abdomen while the woman is in erect posture or lying upon her side.

§ 18*c*. *The active movements of the child* become perceptible for the first time usually in the fourth month. They are at first extremely feeble, and in some cases remain so during the whole period of gestation. There are some rare cases in which no movement whatever has been felt by the mother throughout pregnancy; and, on the other hand, in some instances of spurious pregnancy the movements attributed to the child are described as violent. In the majority of cases, however, they are very distinct in the latter half of pregnancy. They are perceived by laying the hand upon the abdomen, and making gentle pressure upon it, or after dipping the hand in cold water before touching the skin. Sometimes an escape of gas from one portion of the intestine to another, or even the involuntary contraction of the abdominal muscles or of the uterus itself, may momentarily deceive the examiner, but a little attention will prevent all chance of mistake from these sources. The child may not always be made to execute movements; hence, both the woman may be pregnant and the child

alive, without its being revealed at the time by this mode of physical examination of the abdomen.(*i*)

§ 19. 6th. *Pulsation of the fœtal heart.*—The pulsation of the fœtal heart resembles the ticking of a watch, and is discoverable at different portions of the uterus, according to the period of pregnancy at which the observation is made. These sounds cannot be mistaken for any other heard in the abdomen, since the pulsation is a double one, and not isochronous with the maternal pulse, being generally about 130 beats in the minute, varying, however, considerably in frequency, and becoming less frequent as pregnancy advances. These pulsations are first distinctly audible about the middle of the fifth month; but M. Dépaul says that it is possible to hear them one month earlier than this period, he having succeeded in perceiving them, with great distinctness, by depressing strongly the abdominal walls, and placing the stethoscope upon the fundus of the uterus. This manœuvre would evidently succeed only in very thin persons, and when employed by a practised auscultator. The sounds may be more audible at one examination than at another; indeed, to an inexperienced auscultator, they may frequently be inaudible. It is extremely rare, however, *not* to find them in the last three months of pregnancy, except when the fœtus is dead. Of 906 women examined at this period of pregnancy, says M. Dépaul, the sounds were absent in 8 only. Yet in some rare cases they have been inaudible throughout pregnancy. The auscultation of the fœtal heart is, therefore, a test of the existence of a fœtus far more reliable than any other sign or combination of signs. It is easy of application, can be employed at a comparatively early period, and can hardly ever fail of being discovered when pregnancy really exists.

§ 20. 7th. *Other sounds.*—There are two other sounds indicative of pregnancy, which are ascertained by auscultation, but neither of which can afford the same positive proof as the pulsation of the fœtal heart. These are the uterine and the umbilical *souffle*. The first is a peculiar blowing, cooing, or whistling sound, audible over a greater or less extent of the

(*i*) Dépaul, Traité Théorique et Pratique d'Auscultation Obstetricale.

uterine tumor, sometimes confined to one spot, and generally most audible in the lower and lateral portions of the uterus. It is said to be caused by the passage of the blood through the uterine arteries. It is isochronous with the pulse of the mother. It has been perceived as early as the tenth week, but most generally cannot be discovered until a later period. Its intensity increases up to the end of the seventh month (Dépaul). Of 307 women who had passed the fifth month, this author observed the uterine souffle in 295. M. H. F. Nägele(*k*) found it absent in only 20 cases out of 600. In affixing a value to this phenomenon, as a sign of pregnancy, the observations of M. Dépaul render it positive that a souffle perfectly similar to this is heard when the uterus is developed from any other cause than pregnancy. He relates a number of cases which show conclusively that such is the case; in some of them, post-mortem examination disclosed fibrous and carcinomatous tumors imbedded in the walls of the uterus.(*l*) If, however, a certainty can be obtained that the development of the uterus is not due to this cause, the sign is hardly less characteristic than the fœtal cardiac pulsation.

§ 21. The sound discovered and described by Dr. Evory Kennedy, and called by him the umbilical sound (from the supposition that it proceeds from the umbilical vessels), is of trivial importance in the diagnosis of pregnancy. It is not audible in the majority of cases, requires an experienced ear, and, when found, is a superfluous sign, because the pulsation of the fœtal heart and the uterine souffle will be also perceptible at the same time, and are not open to the same objections as is the one in question.

§ 22. 8th. *Kiestein in the urine.*—Very little need be said of this substance as a test or sign of pregnancy. The name of *kiestein* is applied to a substance which occurs at first as a fleecy cloud, and afterwards as a fatty pellicle or scum, in the urine of pregnant women, after it has been allowed to stand for a

(*k*) Die geburtshülfliche Auscultation, Mainz. 1838.

(*l*) The same opinion is held by Kiwisch, whose opportunities for verifying the accuracy of his views are very extensive, and whose critical acumen and sound judgment have gained him a wide reputation.—Vid. *Klinische Vortraege.* Bd. 2, p. 561. Prag. 1849.

few days. Dr. J. Braxton Hicks(*l*[1]) recommends the addition of two teaspoonfuls of rennet to three fluidounces of urine to hasten the formation of the pellicle. Its nature is not very well understood, but Dr. Golding Bird supposed it to contain the caseous elements of milk mixed with the earthy phosphates. There is, however, considerable discrepancy of opinion respecting its constitution, while at present few are disposed to look upon it as of any value as a sign of pregnancy. Among the later observations are those of Dr. Veit, who comes to the conclusion that the so-called pellicle of kiestein is no peculiar matter at all, and is not of the slightest value as a sign of pregnancy. In urine of both non-pregnant and pregnant women pellicles are formed, containing vibriones and frequently the triple phosphate; the chief difference between the respective urines being, that in that of pregnant women, alkaline, and in that of non-pregnant women, acid reaction more frequently manifests itself. This may depend, perhaps, upon the greater concentration of the urine in pregnancy, and the larger portion of mucus mixed with it.(*m*) Tanner, however, treats of the presence of this substance among the minor signs of pregnancy as tending to strengthen other evidence.(*m*[1])

Montgomery, after reviewing all the evidence which has been published upon this subject, and comparing with it his own experience, concludes that we should be very slow to place any confidence in the sign in question, except as a "corroborative indication."(*a*) Dr. G. T. Elliot, who conducted his investigations at the Bellevue Hospital, New York, concludes that there is nothing positive to be learned from the urine in regard to the existence of pregnancy, and that its appearances can scarcely even be called corroborative.(*b*)

In conclusion, we draw attention to the fact, that, as the result of his vast experience, Casper says that disputed pregnancy is of much more rare occurrence *in foro* than is generally believed to be the case.(*b*[1])

(*l*[1]) Lancet, Sept. 17, 1859.
(*m*) Am. Journ. Med. Sci., Jan. 1852, p. 259.
(*m*[1]) Op. cit. p. 136. (*a*) Op. cit. p. 307.
(*b*) New York Journ. of Med., Sept. 1856, p. 181.
(*b*[1]) Forensic Medicine, New Sydenham Society's Translation, vol. iii. p. 349.

CHAPTER II.

DELIVERY.

§ 23. 1st. *Signs of recent delivery.*—Within a week or ten days after delivery at term, the following signs are more distinct and well marked the earlier the examination is made. The countenance of the female is pale, her skin warm and moist, the body languid, and the mind and feelings very impressionable. The breasts are more or less distended, and their veins very distinct upon the surface. They are increased in weight, and the knotty masses of lactiferous tubes and glands are very easily felt. The nipples are prominent, and watery milk spontaneously or by pressure exudes from them. The integuments of the abdomen are loose, lying in folds, marked with livid lines, which at a later period become whiter than the surrounding skin, and resemble scars; the uterus can be felt behind the pubis, like a large firm ball; the external organs of generation are moist, relaxed, and swollen, and the vagina, both at its entrance and throughout, is very capacious, and free from folds. The mouth of the womb is low, open about three-quarters of an inch, its margins very soft and relaxed, and sometimes slightly lacerated. A sanguinolent mucus exudes from the internal organs of generation. This discharge is known under the name of the lochia; its odor is peculiar, and easily recognized by those who have once perceived it. Such are the principal signs of delivery, and in their combination they present a characteristic picture which can leave no room for doubt of a recent confinement. Taken separately, however, there is hardly any one which is not liable to exceptions. Thus milk may be secreted independently either of pregnancy or delivery, as has been shown in the chapter on the "Signs of Pregnancy." Yet the manner in which the secretion takes place after delivery, with the attendant warmth of the skin, the turgescence of the glandular

structure of the breast, and a certain amount of constitutional sympathy, called "milk fever," can rarely, especially during the first few days, allow one to be in doubt of its cause. There are, indeed, numerous cases in which no milk is secreted, and although even in these a certain degree of turgor and warmth may generally be observed, yet an opinion must be based upon a further examination.

§ 24. A *microscopic examination* of the milk may sometimes contribute to prove the recent occurrence of parturition. This solved all doubt in a case reported by Mr. Mercer Adam. The body of a new-born child, much decomposed, was found in a moss in the South of Scotland; it appeared to have been dead four or five weeks. Suspicion having fallen upon a young woman who was supposed to have been delivered secretly about that time, she was arrested, and acknowledged that she had borne a child about a year and a half before, which she had nursed until within three months of her apprehension, but firmly denied having been recently delivered. No feasible plan of deciding the question appearing, some one suggested that her milk should be examined by the microscope. This was done, and it was found to abound in *colostric* globules. "This showed parturition to have lately occurred." The girl finally confessed that she had recently given birth to a still-born child.(*n*)

§ 25. A case is reported by Rothamel(*n*[1]) in which stains of milk, vernix caseosa, and meconium were analyzed, and evidence thereby obtained of a concealed birth and child murder. The presence of milk, possessing the peculiarities belonging to that fluid soon after delivery, was considered to be proven by finding fat, sugar of milk, caseine, potash, lime, and magnesia, with hydrochloric, sulphuric, and phosphoric acids. Vernix caseosa was evidenced by fat, mucus, and carbonate of lime, while meconium appeared to be indicated by fat, cholesterine, mucus, fatty coloring matter, with the absence of biliary coloring material and bile acids.

§ 26. The condition, as above described, in which the genital

(*n*) Edinburgh Monthly Journal of Medical Science, May, 1853.
(*n*[1]) Henke, vol. xxxix. part I.

organs, after delivery, are found, is one which it is entirely impossible to mistake for the result of disease, accident, or intentional injury. The only difficulty in ascertaining the fact of delivery having taken place arises in those cases where an examination has not been made at a sufficiently early period. After the establishment of the flow of the milk, and the disappearance of the relaxed and tumid condition of the genital organs, there remain hardly any other signs than the whitish streaks before referred to, indicative of the previous distension of the abdomen, and, in addition, the state of the os uteri. If it can be shown that abdominal dropsy or tumors have not been present, then the white lines, being usually permanent, afford good evidence of the woman having borne one or more children, but allow no inference as to the date of delivery, except that it has not been recent. The *os uteri*, in a woman who has been delivered once or more than once, differs from its virgin state, in being more open, and having its margins irregularly notched, or even torn. Occasional exceptions to this statement are met with.

§ 27. In conclusion, it may be stated that the medical proof of recent delivery, from an examination of the living woman, cannot be established with perfect certainty after the lapse of a week or ten days, if the female have already borne children; if it, however, have been a first labor, the existence of the whitish streaks upon the abdomen, and the altered condition of the mouth of the womb, will afford strong suspicion of delivery having taken place at some former period, which cannot be more nearly determined.

§ 28. 2d. *Signs of delivery in the dead.*—These are extremely easy of recognition. It is evident that, in addition to the dilated and relaxed state of the vagina and vulva, the volume and capacity of the uterus, the thickness of its walls, the blood upon its inner surface, and the lacerated appearance of that portion of it to which the placenta was attached, are unmistakable signs of recent delivery. The uterus, after delivery, does not return to its former size until after the expiration of eight or twelve weeks, but will be found during this period still larger than before pregnancy, its walls thick and firm, but not vascular, although traversed by dilated veins, and the

mucous membrane of the *os tincæ* softened, as if excoriated, vascular, and covered with mucus. The appendages of the uterus partake of the vascularity which characterizes it at the epoch of delivery, but they soon regain their ordinary aspect. The rate of return of the uterus to its normal size after parturition is irregular, depending upon its energy during labor, the period of pregnancy at which this process occurs, the occurrence of hemorrhage, etc., and consequently any attempt to infer from its condition the precise date of delivery must prove deceptive.

§ 29. 3d. *Corpus luteum.*—It has been supposed that the finding of a *corpus luteum*, or trace of a ruptured Graafian vesicle in the ovary, was introvertible proof of the previous existence of pregnancy. This opinion can no longer be maintained. The body which is found in the ovary, as the result of the rupture of a Graafian vesicle, indicates the escape of an ovum, but not necessarily the occurrence of impregnation. It has, indeed, been supposed that if a *corpus luteum* were formed in the ovary, this would be a reliable proof that fecundation must have occurred. This view is, however, not supported by the later investigations into the physiology of menstruation and reproduction.

§ 30. The fact is now, perhaps, universally admitted, that the maturation and expulsion of ova, probably at the menstrual period, or immediately after it, take place independently of all sexual intercourse. The act of expulsion or discharge necessarily involves a rupture of one of the Graafian follicles, and the locality is indicated by a *corpus luteum* and a cicatrix.

§ 31. The following is a description, by Dr. Dalton, of the *corpus luteum* found in the ovary of a girl who destroyed herself with oil of tansy, in the fourth month of pregnancy. The fœtus was found in the womb. "The left ovary, which hung down a little lower than the right, had near its external extremity a small conical prominence, where the fibrous coat was wanting, and its place occupied by peritoneum alone. There was a very slight appearance here of a cicatrix, visible only on close inspection. There was no unusual vascularity here or at any other part of the ovary. Beneath this prominence the corpus luteum could be felt through the ovarian

tissue, tolerably firm and well defined, showing the form of a sphere compressed laterally, much like that of the crystalline lens. On dividing the ovary longitudinally through the prominence, the corpus luteum was exposed. It presented nearly a circular section, measuring seven-eighths of an inch in its long diameter, and three-fourths of an inch in its short. It consisted externally of a convoluted wall of a dull yellow color, measuring at its deepest part a little over three-sixteenths of an inch in thickness. The space inclosed by the yellow wall was occupied by a colorless, reticulated, fibrous coagulum, which possessed a few minute vessels. This central coagulum was much compressed laterally, so that, although it presented a cut surface of about half an inch in diameter, it had hardly more than one line in thickness. There was no cavity or fluid anywhere. Both ovaries were carefully divided in every direction, but only one other body was found having any resemblance to a corpus luteum, and that was so small and imperfect as to be hardly recognizable. There were many Graafian vesicles in the interior of each ovary, varying in diameter from three-sixteenths of an inch downward, but none at all prominent on the surface. Both ovaries were quite healthy."(*o*)

§ 32. The question of practical interest in inquiries relative to the fact of impregnation or delivery having occurred, is whether there is a sufficient distinction possible between the corpora lutea of simple menstruation and those of pregnancy to enable us to declare with *positiveness* to which cause it may be properly ascribed. It would certainly be a gratifying result of scientific observation, if this question could be answered in the affirmative.(*p*)

(*o*) American Journal of the Medical Sciences, January, 1852.

(*p*) M. Coste, in his splendid work upon Embryology, says, that, during the first eight or ten days after the escape of the ovum, it is impossible to find any difference between the corpus luteum of menstruation and of pregnancy; after this period the first assumes a retrograde course, while the latter, attaining a larger size than the other ever reaches, and becoming in every way more developed, remains stationary until about the end of the third month, at which time it begins to decline, and between the sixth and the ninth month has lost at least two-thirds of its volume; still occasionally it is completely absorbed before delivery. During the period of decadence, it is difficult to distinguish the corpus luteum of pregnancy from that of menstruation. M.

§ 33. M. Longet(*q*) gives a concise and satisfactory description. He says: "We must distinguish *two kinds of corpora lutea*—those which result from the cicatrization of a follicle, after the spontaneous expulsion of an ovum, without any subsequent conception; and those which are produced by the same process, after the expulsion of an ovum followed by conception, and especially by gestation. Those belonging to the first class rapidly pass through their different stages, never attain a high degree of development, are much inferior to the others in size, rapidly assume a yellow coloration, fade again in a few days, and in the course of one or two months become retracted and completely concealed in the ovarian tissue. The second species of corpora lutea, participating in the congestion and functional activity, which are established in all the sexual organs during gestation, attain a size sometimes greater than that of the ovary itself, and pass so slowly through the different stages of their development and atrophy, that they are still perceptible at the termination of pregnancy; they gradually diminish in size, in proportion to the growth of the fœtus, and the approach of the end of gestation."

§ 34. Dr. Dalton,(*r*) in his valuable monograph on this subject, says: "There can be no doubt that *in the first periods*, the corpus luteum follows the same course of development, whether the discharged ovum becomes impregnated or not. Together with the rupture of the vesicle the same effusion of blood takes place in either case, followed by a gradual absorption of the coloring matter of the clot, with hypertrophy and folding up of the membrane of the vesicle. When, however, the ovum becomes impregnated, and continues its growth in the uterus, the corpus luteum, instead of reaching its maximum of devel-

Coste differs from Raciborski, Pouchet, and most other physiologists who have made researches upon this subject, in regard to the cause of the color of these bodies, believing it not to be due to an extravasation of the coloring matter of the blood, but to other causes which the reader will find fully explained in his work.—*Histoire générale et particulière du Developpement des Corps organisés.* Paris, 1147.

(*q*) Physiologie. Paris, 1850, vol. ii. p. 88.

(*r*) Prize Essay on the Corpus Luteum of Menstruation and Pregnancy, by Jno. C. Dalton, Jr., M. D., published in the Trans. of the Am. Med. Assoc., vol. iv. 1851.

opment at the end of three weeks, and afterwards undergoing a rapid process of atrophy, *continues to develop itself* for a considerable period, and does not, in fact, become very decidedly retrograde until after the termination of pregnancy." He states, moreover, that the yellow color of the *corpus luteum* of pregnancy fades more rapidly than that of menstruation in proportion to its size and the activity of the changes it undergoes.

§ 35. Bischoff,(*s*) in a paper upon this subject, which with him was one of close investigation for many years, states that he had the opportunity of examining the ovaries in thirteen women who died while menstruating or in the pregnant condition. The results he obtained confirm the truth of the theory, that, at every menstrual period, a Graafian follicle ripens, swells, and bursts, and that, the ovum escaping, a corpus luteum is formed. Still, in ordinary menstruation, it never attains the full development which characterizes it when pregnancy exists. It rapidly becomes contracted, and at the succeeding menstrual period is already indistinct, and becomes gradually more and more so, the color changing from yellow to brown and black, and a puckered cicatrix on the surface of the ovary is soon the only trace of its existence. The *corpus luteum* of pregnancy, on the other hand, progresses steadily in its development, and attains a size never reached by that of menstruation. It lasts through the whole period of pregnancy, although diminished in size after the sixth or seventh month. and disappears after delivery. In the early periods, therefore, the difference between the two bodies is too slight to be relied upon; after delivery it is still difficult to distinguish that of pregnancy from those of fourteen days' or three weeks' standing, resulting from menstruation.

§ 36. It is hence very plain, that, in the many cases in which the fact of impregnation having taken place is important to be known, we cannot rely with confidence upon the evidence derivable from the corpus luteum. We doubt, moreover, whether, in view of the still very conflicting opinions among

(*s*) Zeitschrift für rat. Med. Bd. iv. H. 1, abridged in Brit. and For. Med. Rev., April, 1854, p. 561.

physiologists in regard to the nature, origin, and diagnostic value of corpora lutea, positive statements derived from this source would be well received. While we feel persuaded that there is, as has been so well described by M. Coste and Dr. Dalton, a striking difference between these bodies in mere menstruation and pregnancy, yet it should not be forgotten that many of the most experienced anatomists and physiologists of the day have failed to recognize it. We beg leave to refer those of our readers who desire to learn in detail the state of knowledge on this subject, to Dr. Dalton's paper above quoted. In conclusion it may be added, as that admirable observer and microscopist, Mr. Wharton Jones, remarks, that "though *physiologically* one may be permitted to speculate on the relation between the occurrence of corpora lutea in the ovaries and preceding coitus, it would be rash and unwarrantable in any one to pronounce positively from the occurrence of a corpus luteum in the ovaries that coitus had taken place. The discovery of an ovum in the uterus, in process of development, could alone, in the present state of knowledge, warrant such an affirmation in a court of law. But, on the other hand, the absence of a corpus luteum could not warrant the affirmation that coitus had not taken place.(*t*)

§ 37. 4th. *Feigned delivery.*—Delivery may be feigned from a variety of motives, into which it is not necessary for us to enter. A medical inspection can hardly fail to expose the deceit, and usually the collateral proof is sufficient. We have abridged the following case of feigned delivery, on account of the wonderful ingenuity with which the imposture was conducted. Dr. Albert relates that he was called upon to see a poor girl of twenty-one years of age in her last illness. In the presence of the physician and clergyman of the district, she gave the following narrative and confession. Some eighteen months previously she entered the service of a married couple as housemaid. Her master, who was young and handsome, and assumed the title of baron, had no children. He succeeded, by tempting presents, in overcoming her virtue. He

(*t*) Microscopical examination of an early *corpus luteum*. Lond. Med. Gaz., 1844.

then represented to her that an important inheritance depended upon his having an heir; but having been married five years, and his wife still proving unfruitful, he had no longer any hope of having children by her. He then proposed to the girl that in case she should prove with child, and would allow him to cause it to appear as his own legitimate offspring, he would not only give her a considerable sum of money, but would also let her remain in the house of her mistress, in order that she might be always near her child. She accepted the proposal, and as soon as she found herself to be pregnant the preparations were made to carry out the projected imposture. The girl remained in the house, living in the most retired manner, while her mistress played the part of a lady in an interesting condition. She introduced wool and folded napkins under her dress, and thus gradually let her rotundity become apparent, rubbed her breasts frequently, in order to develop them, fainted in church, was often ailing, and sent for midwives and consulted them concerning her symptoms; physicians were also called upon, and every means taken to make public her happy expectations, so that no one had any suspicion that she was not pregnant. The traces of her monthly sickness were carefully concealed.

§ 38. At last, in due time, the young girl fell in labor, which was allowed to advance considerably before the midwife was sent for. In the mean time the bed was arranged in the following manner. A board was taken out of the bottom of the bedstead, and immediately above this opening a hole was made through the mattress and paillasse, large enough to allow the legs of a person to pass through and rest upon the floor. The bed was made in such a manner as to sink down towards the headboard, while it was elevated below the opening in the mattress. The mistress now leaned in a sitting position, with her legs through the opening in the bed, and supported against the headboard, while the servant lay across her lap on a feather-bed, in the attitude of labor. Her body was entirely concealed by the bed-coverings, which also concealed her mistress up to the neck. The midwife, upon her arrival, found the baroness, as she supposed, in the throes of labor; she made the necessary examination, promised a speedy deliverance, and

gave the usual words of comfort. The lady, however, screamed lustily at every pain, the approach of which she became conscious of by the involuntary contractions of the poor girl's body; while the latter suppressed her cries as much as possible, except when she could mingle them unperceived with those of her mistress. A living male child was soon born, and the after-birth followed it immediately. While the nurse was busy in washing and dressing the child in another room, the girl escaped from the bed into an adjoining chamber. The baroness, before the return of the midwife, drew her feet up from the opening, covered it over with the bed, and, stretching herself out upon it, forbade the midwife (who was desirous of ascertaining her condition) to touch her, except to wash off the blood with which she had previously soiled her thighs, declaring that she was in so much pain that she could not endure the slightest touch. The child was baptized, and on the second day put to the breast of the lady. As, however, very naturally, it found nothing there, the midwife was discharged, on the pretext that the baroness's own attendant could now take care of the child, which, immediately upon her departure, was confided to its own mother. The remainder of the girl's history, not being essential here, is omitted. Unexplained circumstances prevented the fraud from succeeding. The authors of the conspiracy fled, leaving the servant-girl sick and in a state of destitution. She died, from the effects of privation and exposure, shortly after having made this confession.(*u*)

§ 39. Dr. Rüttel relates a case of pretended pregnancy and delivery, in which a girl, with the hope of persuading her lover to marry her, had stolen a child from eight to ten weeks old, and endeavored to pass it for her own. The fraud was easily detected from the entire absence of any signs of recent delivery, and from the child being evidently older than was consonant with her statement.(*v*) Where, as has in some cases happened, a child of the proper age has been substituted, the truth will be elicited by medical examination, or, where this cannot be obtained, the imposture is apt to be disclosed by some accidental or unforeseen circumstance.

(*u*) Henke's Zeitschrift, vol. xliv. p. 172. (*v*) Ibid. Erg. H. 31, p. 312.

CHAPTER III.

DURATION OF PREGNANCY.

§ 40. 1st. *Presumption that the child born in wedlock is legitimate.*—The rule in this country, as in England, is, that, when the husband has access to the wife, and the child is born within due time subsequent, no evidence, short of absolute impotence on the husband's part, will justify a judgment of illegitimacy. The question of access, however, may be made to rest upon circumstances.(*w*) And among these circumstances may be taken proof of open cohabitation with another man, and repudiation by the husband's family of the alleged child.(*x*) When the marriage takes place when the mother is so far advanced in pregnancy that her situation must have been known by the husband, this will be considered a recognition of legitimacy.(*y*)

§ 41. 2d. *Protracted Gestation.*—(1) *Usual duration.* The duration of pregnancy in woman is, according to general medical and popular observation, about nine calendar months. Nine calendar months give a variable length of time, since they may contain either 273, 274, 275 or 276 days. Hence those who have thought precision was desirable have described the term of pregnancy as comprising ten lunar months, forty weeks, or 280 days. This, indeed, was the most ancient mode of reckoning. It is given by Hippocrates, was incorporated into the Roman laws, and is frequently alluded to by the Latin poets. The celebrated Harvey says: "Unquestionably the ordinary term of utero-gestation is, that which we believe was kept in the womb of his mother by our Saviour Christ, of men the most perfect; counting, viz., from the festival of the Annunciation

(*w*) Com. *v.* Shepard, 6 Binn. 283. See 3 Hawks, 623.

(*x*) Com. *v.* Stricker, 1 Br. App. xlvii.; see Com. *v.* Wentz, 1 Art. 269; Stegall *v.* Stegall, 2 Brock. 256; Bowler *v.* Bingham, 2 Munf. 442, 3 Munf. 599.

(*y*) Stegall *v.* Stegall, 2 Brock. 256.

in the month of March, to the day of the Blessed Nativity, which we celebrate in December. Prudent matrons calculating after this rule, as long as they note the day of the month in which the catamenia usually appear, are rarely out of their reckoning; but, after ten lunar months have elapsed, fall in labor, and reap the fruit of their womb the very day on which the catamenia would have appeared had impregnation not taken place."(z)

§ 42. There is a remarkable correspondence between these views of the illustrious demonstrator of the circulation and those which are at present attracting attention. The idea has of late years been put forward and sustained by direct observation, that, in women whose menstrual function is regular, gestation will terminate at the tenth menstrual period after that upon which conception has ensued. Thus, as the ordinary menstrual interval is about twenty-eight days, the ordinary duration of pregnancy would be a few days less than 280 days, varying according to the time occupied by the monthly flow.(z¹) On this principle, the apparent difference among women in the length of their pregnancies might be explained by reference to the well-known variations in the length of the inter-menstrual periods; protracted gestation occuring in those having a menstrual interval naturally of more than twenty-eight days, and apparently premature confinements in those who menstruate at shorter intervals. The successful establishment of such a law would afford striking confirmation of the general truth of a popular belief reposing upon ages of experience. The greater tendency to abortion or premature delivery at the recurrence of the menstrual epochs, and the usual re-establishment of the menstrual function, within one month after parturition, in case the woman does not suckle her child, afford a presumption in favor of its correctness. Nevertheless, much additional and careful observation is required before we can be permitted

(z) Harvey's Works, Willis's Translation, p. 529.

(z¹) In a practical point of view, says Dr. Tyler Smith, we may consider that the average duration of pregnancy is about 280 days from the date of the last catamenia, or about 274 or 275 days from the time of coitus, when this can be ascertained. (Lancet, Mar. 1856, p. 333.)

to base a positive opinion in legal cases on such a mode of calculation.(a)

§ 43. (2) *Mode of reckoning.*—The discordance in medical testimony upon the subject of the natural duration of pregnancy and the possible deviations from it, is accounted for by the want of a *fixed period* from which to date *its commencement.*

The *mode of reckoning* is various. Much reliance is placed by some women upon *peculiar sensations* experienced at the moment of conception. In some instances, they are no doubt thus enabled to calculate the probable duration of pregnancy with considerable certainty. Dr. Reid(b) says, that he has occasionally met with cases in which this mode of fixing the exact time of conception proved, by the result, to have been correct; but that, in a much larger number of instances, the females were very considerably out in reckoning by trusting to this evidence. As a general rule, he says, "it will prove most fallacious, and in disputed cases of legitimacy it is of far too uncertain a character to rely on." We may add, that these sensations are undefined in their nature, are unperceived by a great many women, have no necessary connection with conception, and, if referred to at a late period in the pregnancy or after delivery, the evidence must be utterly unworthy of consideration. Hence, in questions of *paternity*, the sensations alleged to have been perceived at the time by the women cannot be regarded.

§ 44. (a) *Cause of conception.*—In an indictment for bastardy the mother will not be permitted to decide which of the connections about the same time was the operative cause of conception.(c) "The organs of conception, like those of digestion," said Chief Justice Lewis, "perform their appropriate offices, without the volition of the female. She is not conscious, at the moment of the occurrence, of what has taken place. It is only by *inference* that she can fix the paternity of her offspring. If her intercourse has been confined to one individual, there

(a) Vid Cederschjöld; Schmidt's Jahrbücher, 1849; Suppl. Bd. pp. 323 and 394, also Schuster, Henke's Zeitsth. 1. H. pp. 1–97.

(b) On the Duration of Pregnancy in the Human Female, by James Reid, M.D., Lancet, 1850.

(c) Com. v. Fritz, 8 P. L. J. 43; Com. v. McCarty, 4 P. L. J. 140.

is no difficulty in drawing a correct conclusion from the premises. But, if she has exposed herself to the embraces of several, at or about the time she became pregnant, she has placed it out of her power to draw any safe conclusions on the subject. Where causes are shown to exist, each of which is adequate to produce the effect, and there are no circumstances to determine the mind in favor of either, the true cause must necessarily remain uncertain."(*d*)

§ 45. Another mode of calculation is from the *period of quickening.* In treating of the "signs of pregnancy," we have already shown the fallacy to which any calculation founded upon this date is liable, since it may occur as early as the tenth week, as late as the twenty-sixth, or may never be perceived at all.

§ 46. (*b*) *Cessation of the catamenia.*—The mode of reckoning adopted by women themselves, as well as by their medical attendants, is usually from the *cessation of the catamenia*, or from a period midway between the last monthly discharge and its next expected recurrence. It is at once obvious that such a computation must yield merely an approximate result. If calculated beforehand, it may happen to prove correct, or it may either fall short of or exceed the actual duration. Conception may take place at any time in the interval between one menstrual period and another. Hence, by reckoning from the last occurrence of the catamenia, we may be in error by the whole length of the menstrual interval—viz., 23 to 25 days—since impregnation may have been effected immediately before the anticipated return; or, on the other hand, the real duration of the pregnancy may be apparently shortened, by referring the impregnation to the end instead of the beginning of the menstrual interval. By adopting the common way of dating from midway between the two periods, the evil of falling into an extreme error is indeed avoided, but certainty is no better attained.

§ 47. (*c*) *Arrest of menstrual discharge.*—Another source of error lies in the *irregularity* of the menstrual function. If this continue to be performed during pregnancy, the female may

(*d*) Com. *v.* McCarty, 4 P. L. J. 130.

become very much perplexed in her calculation. By dating from the complete cessation of the monthly discharge, she may make her pregnancy appear much shorter than it is in reality, or, on the other hand, add to its real duration by ascribing its commencement to some antecedent period at which she may suppose that she experienced the "peculiar sensations" above spoken of. In general, however, the mistake by which protracted cases may be accounted for depends upon the fact of the catamenia having been arrested by some accidental cause before impregnation occurred. The female is often sustained in her error by the appearance of symptoms not unlike those of real pregnancy, which are apt to ensue upon the arrest of the catamenial discharge. Thus a lady, mentioned by Dr. Reid, who had borne five children, and had never before had any stoppage of the menses, except when pregnant, missed a period about ten months after the birth of her last child, which was at that time weaned, and naturally concluded that she was again *enceinte;* this opinion was confirmed by the second period also passing without any catamenial appearance. All the usual general symptoms of pregnancy occurred in succession, but, to her great surprise, she did not quicken as usual at the fourth month, and this occurrence did not take place until the supposed seventh month of her pregnancy. The infant was born exactly twelve calendar months after the last appearance of the menstrual functions. Dr. Reid remarks: "We may readily comprehend that, in this case, there was an accidental stoppage of the catamenia for three months, at which period conception took place. Fortunately, the apparently late period at which the movements of the fœtus were perceived, but which, in reality, was the usual one at four months, corroborates the above fact."(*d*[1])

§ 48. Although, when the duration of pregnancy is reckoned in this manner—viz., from the arrest of the monthly discharge—the calculation is subject to the errors indicated, which are again further increased by the sympathetic phenomena often ensuing upon the stoppage of the catamenia from other causes; yet it cannot be denied that there are cases thus reckoned

(*d*[1]) For numerous illustrative cases, see Reid, Lancet, Sept. 1853, p. 236.

which cannot be so explained. In two cases, for example, related by Prof. Simpson,(e) of Edinburgh, the actual enlargement of the uterus, corresponding to its usual size at the eighth or ninth week of pregnancy, was ascertained by manual examination at this period after the supposed commencement of pregnancy; and yet in one case the number of days which elapsed from the last menstruation to delivery was 336, and in the other, 332. Allowing an inter-menstrual period of twenty-three days (since the impregnation may have occurred only at its termination) the actual duration of pregnancy would have been, in each case, respectively 313 and 309 days, or at least 33 and 29 days in these two cases beyond the generally admitted limit. We might, indeed, to show that a manual examination is not always a reliable indication, adduce cases related by another distinguished author, in which it merely confirmed the female in her error. Thus Dr. Reid relates, that "A married woman aged twenty-five, who had not seen her husband for eight months previously, having procured a letter for a lying-in hospital, was admitted into it, as labor-pains had continued for several hours. She had experienced all the usual symptoms of pregnancy, and the abdomen was much enlarged. She was examined by the midwife of the establishment and by the junior medical officer, and was informed that she was only eight months advanced in pregnancy, and not at her full term. After remaining three days in the hospital, as the pains had ceased, she left, but was recommended to come back immediately if the pains returned. As she continued perfectly free from them for the space of another month, she then applied to a physician for his advice, who referred her to me. On examining the patient, she did not present one single sign of pregnancy, except that the abdomen was somewhat enlarged, but the umbilicus was depressed and it was quite evident that she had never been pregnant." Nevertheless, we would be slow to believe that an accoucheur of the eminence of Dr. Simpson could have been deceived in

(e) Contributions to Obstetric Pathology and Practice, by J. Y. Simpson, M.D., Professor of Midwifery in the University of Edinburgh. Monthly Journal of Medical Science, July, 1853.

supposing, in the cases referred to, that the developed size of the uterus was owing to the existence of pregnancy at the time of the examination. Yet we cannot fail to remind the reader that the recognition of pregnancy as early as eight or nine weeks after conception by the vaginal touch, and especially where, as in these cases of Dr. Simpson, "spurious pregnancy" had before existed, and there was, moreover, chronic inflammation and enlargement of the cervix uteri, is generally considered by authors to be, if not impossible, yet far from certain.

§ 49. The value to be attached to the opinions of accoucheurs upon the subject of protracted gestation depends naturally upon a consideration of the fallacies now enumerated. In many cases their only guide is the assertion of the mother, relative to the time of the supposed impregnation, the interruption of the menstrual discharge, and the period of quickening. In others, reliance is placed upon the degree of the enlargement of the womb; and in others, again, they are obliged to found their opinion partly upon the testimony of the mother and partly upon their own observation. An error in any of these elements for the formation of an opinion, will necessarily invalidate its accuracy; and hence, the testimony of an accoucheur as to his own experience, or that of a large number as to theirs, does not offer any security against error. If, for example, a physician should conscientiously believe and testify that he had witnessed a case of gestation protracted to twelve months, the grounds for that opinion become a legitimate subject of examination. The sources of error have been shown, we think, to be such that it can hardly be in the power of any man to give an unqualified opinion of the duration of pregnancy in any given case, unless, perhaps, as we shall hereafter see, no more than a *single act* of intercourse has been possible. For this reason, testimony of the kind cannot become authoritative, the fallacies inherent in every mode of reckoning not being in the least diminished by the *number* of cases brought in evidence.(*f*)

(*f*) The following is an abstract of the celebrated Gardner Peerage case, which came before the House of Lords in 1825: "Alan Legge Gardner, the

We will, therefore, not weary the attention of the reader by adducing the discordant opinions of accoucheurs upon this point, nor refer to isolated cases in which, upon insufficient evidence, the duration of pregnancy was considered to have been much protracted beyond the usual period.(f^1) Our object

son of Lord Gardner by his second wife, petitioned to have his name inscribed as a peer on the Parliament Roll. The peerage was, however, claimed by another person, Henry Fenton Jadis, who alleged that he was the son of Lord Gardner by his first and subsequently divorced wife. It was contended that the latter was illegitimate; and in order to establish this point, the evidence adduced was partly medical and partly moral. Lady Gardner, the mother of the alleged illegitimate child, parted from her husband on board of his ship, on the 30th of January, 1802. Lord Gardner went to the West Indies, and did not again see his wife until the 11th of July following. The child whose legitimacy was disputed was born on the 8th of December of that year. Therefore, the plain medical question, taking the extreme view, was, whether a child born 311 days (*forty-four weeks and three days*) after intercourse (from January to December), or 150 days (*twenty-one weeks and three days*), from July to December, could be considered to be the child of Lord Gardner. If these questions were answered in the affirmative, then it followed that this must have been a very premature or a very protracted birth. There was no pretence that this was a premature case, the child having been *mature* when born. The question, then, was reduced to this: Was this alleged protracted gestation consistent with medical experience? Many medical witnesses, comprising the principal obstetric practitioners in the kingdom, were examined on this point. Their evidence was very conflicting, but a large majority concurred in the opinion that natural gestation might be protracted to a period which would cover the birth of the alleged illegitimate child. On the moral side of the question, it was clearly proved that Lady Gardner, after the departure of her husband, was living in open adulterous intercourse with a Mr. Jadis; and on this ground Lord Gardner obtained a divorce from her after his return. It was contended that the counter-claimant was really the son of Lady Gardner by Mr. Jadis. The decision of the House was, that this claimant was illegitimate, and that the title should descend to the son of the second Lady Gardner."—*Taylor's Medical Jurisprudence*, 6th ed. p. 634.

The decision in this case was based on the proofs of adultery, and not on the medical evidence. Had it depended upon the latter, it is doubtful whether it could have been given. The inability of the medical testimony to withstand the sifting examination of the Attorney-General, fully bears out the statements in the text. (*Vid.* Medical Evidence on the Duration of Pregnancy, with remards and notes by R. Lyall, M.D., 2d ed. London, 1827.)

(f^1) Several cases of alleged protracted pregnancy are reported by Mr. Annan, Edinb. Med. Journ., ii. 712, and Dr. J. M. Duncan, *ibid.* p. 967. Dr. Buzzell, of Mass., met with a case in which the dead fœtus was retained

is, to ascertain what degree of precision is attainable for an opinion relative to the true duration of pregnancy, and within what limits it may fluctuate; the general principles thus obtained may then properly be applied to explain apparently exceptional cases.

§ 50. (*d*) *Statistical results.*—If we now, with this view, inquire into the *statistical results* obtained by the examination of a large number of cases of pregnancy calculated from the interruption of the catamenia, we shall find that the errors to which this method is unavoidably exposed give a range to the possible duration of pregnancy which the most credulous will find it difficult to reconcile with ordinary experience. The results which we are about to quote are, according to the testimony of their authors, founded on the most reliable data. Yet it must be remarked, that these data are the statements of the women themselves. An amusing instance is related by Dr. Reid, of an expert midwife, who, when examined in the celebrated Gardner peerage case, deposed that she had once gone ten months with child, that she was always right in her calculations, that she always fainted away at quickening, etc., so that she could not be deceived. Some time after the trial she applied to Dr. Reid, convinced, on such grounds, that she was seven months pregnant. It proved, however, on examination, that she was not pregnant at all.

§ 52. Dr. Murphy has published tables founded upon a registry of the cases observed in the obstetric practice of the University College Hospital for 1844. These tables are made up from the data furnished by the women themselves. The errors to which we have referred as inherent in the ordinary modes of calculation must therefore impair the value of the results obtained, and no precautions can entirely eliminate them. In addition, the class of patients furnishing these statistics should not be lost sight of. Now, with reference to hospital and dispensary practice, it may be observed that the class of women who are the recipients of charity from these institutions can seldom give an accurate account of the date

in the womb for twenty-two months after full term. (Boston Med. and Surg. Journ , June, 1860, p. 400.)

at which they suppose their pregnancy to have commenced, but fix it in their own minds in connection with some domestic or other occurrence which happened about the same time. "With the low orders of Irish," as Dr. Reid justly remarks, "dates on all subjects appear to be totally out of the question, or they are located merely by a recollection that the occurrences took place somewhere near to St. Patrick's day, Boxing day, Christmas, etc. If they think that a decided answer will please, it is often given simply as the result of a wish to effect this object." In order to obviate the errors arising from such sources, as far as possible, this last author was obliged to erase several hundreds of cases from his tables as doubtful, and finally included in his list of 500 cases only 50 from hospital and dispensary practice, the rest being private cases. Yet, with all these precautions, we find that in one case, where gestation was apparently prolonged to the 314th day, it was noted that quickening did not happen until the sixth month, proving, as he himself says, that conception had taken place later than had been thought. "Had minute investigation been made, at an early period, into the remaining five cases which went beyond the forty-fourth week, it is most likely that some similar facts might have been observed." The tables of Drs. Merriman, Murphy, and Reid have been condensed by Prof. Simpson into the table which will be found below, and which the reader will also find in the paper by Prof. Simpson already quoted.(*f*[2])

TABLE.

Dates of Delivery, calculated from the last day of Catamenia.

Week.	Days.	Merriman.	Murphy.	Reid.
37th	From 252 to 259	3	12	23
38th	" 260 to 265	13	14	48
39th	" 267 to 273	4	27	81
40th	" 274 to 280	33	28	131
41st	" 281 to 287	22	39	112
42d	" 288 to 294	15	21	63
43d	" 295 to 301	10	25	28
44th and upwards	" 302 to 326	4	2	84
		114	168	500

(*f*[2]) See *ante*, § 48.

The total number of cases here reported is 782, of which 355, or nearly one-half, went beyond the 280th day, up to the 326th day. If we take the number that went beyond the 274th day, there will be 547, or more than *two-thirds* of the whole number of women in these reports whose pregnancy lasted longer than what has been considered the average duration of this condition.

This astonishing result would be still more striking if we refer to Dr. Murphy's tables alone. In them there are fourteen cases not included in the foregoing table, because delivery took place before the 37th week—viz., 5 in the 33d, 3 in the 35th, and 6 in the 36th week. Dr. Murphy comes to the conclusion that 301 days is the *average limit* of gestation! Two of his cases attained the extreme period of 342 and 352 days respectively, from which, if we subtract the intermenstrual period of twenty-three days (not 28 days), we shall still be left with a protracted pregnancy of 314 and 324 days, dating from the first suspension of the catamenia.

With all the sources of error we have indicated, and with the ludicrous results issuing from the assemblage of so-called facts in the above table, what inference, it may be asked, can be drawn relative to the laws regulating the duration of pregnancy?

§ 53. Before replying to this question, let us look at a class of cases which afford less room for error. We refer to those where there has been but *one act of intercourse.*

In this, as in all other questions affecting female chastity or continence, the evidence is always open to objection, even where there is no apparent motive for deception. Nothing is more common than for an unmarried female in a pregnant condition to acknowledge one single act of weakness, while the suggestion of its having been repeated is indignantly denied. Indeed, to use the expression of a German author, the acknowledgment of a solitary transgression is usually accompanied with a protestation of its having been as little a sin as was possible under the circumstances. However much, in individual cases and with plausible concurrent testimony, we may be inclined to favor the statement of a female in so unfortunate a position, it is, nevertheless, incumbent upon us, in

our endeavors to ascertain the existence of a natural law, to look upon the material before us solely in a scientific light, and examine and judge it accordingly. The possibility of error, therefore, from misstatements upon the part of the female, cannot be lost sight of.

§ 54. An additional source of error, even in the best authenticated cases, lies in determining the *moment of conception.* This, we do not hesitate to affirm, is altogether impossible. So far from conception being always coincident with insemination, as was positively affirmed in the evidence in the Gardner peerage case, experiments upon animals, and observations made upon the human subject, have now shown that a more or less extended interval may elapse between the sexual congress and the conception which follows it, when fruitful. Without entering upon this physiological question, which would lead us into a misplaced discussion, it may be stated without any fear of denial—

1st. That the *ovum* occupies from eight to ten days in its passage from the ovary to the uterus;

2d. That the seminal fluid may retain its fecundating properties in the genital passages for several days;

3d. That conception may take place at any time in the menstrual interval; and,

4th. That, therefore, any calculation based simply upon the date of sexual intercourse may cause the duration of pregnancy apparently to exceed by a few days the normal period.

§ 55. Nevertheless, in the absence of any more precise method of determining the day of conception, we must content ourselves with that which approaches it most nearly, and, making due allowance for errors arising from moral causes, accept as good evidence those cases reported as dating from *a single coition.* Other cases have, indeed, been reported, in which the intercourse was alleged to have taken place but once; but we have rejected all such in which the woman's asseveration could fairly be called in question. In doing so, we have been influenced by no other motive than a desire to attain the truth, convinced that this could only be done by a strict preliminary analysis of each case, in reference to the credibility and stand-

ing of the witness, her motives for self-deception or interest, as well as the position and reputation of the reporter.

In the following table, we have placed together all the genuine cases, of this kind, which we have been able to collect. They amount to fifty-six, and are reported by various authors mostly from their own observation.

TABLE. (*g*)

Of the Duration of Pregnancy, as dated from a single intercourse.

Days.	Reid.	Raciborski.	Rigby.	Lockwood.	Beatty.	McIlvaine.	Montgomery.	Desormeaux.	Merriman.	Girdwood.	Skey.	Anderson v. Whittaker.	Lee.	Dewees.	Total for each date.
260	...	...	1	...	...	...	...	...	...	...	...	...	...	...	1
263	1	...	...	...	...	...	...	...	...	...	...	...	...	...	1
264	1	...	1	...	...	...	...	...	...	...	...	...	...	...	2
265	1	...	...	...	...	...	...	...	...	...	...	...	...	...	1
266	2	...	...	...	...	...	...	...	...	...	...	...	...	...	2
268	...	1	...	...	...	...	...	...	...	...	...	...	...	...	1
270	...	1	...	1	...	...	...	...	...	...	...	...	...	...	2
271	2	...	...	...	...	...	...	...	...	...	...	...	...	...	2
272	1	...	...	1	...	...	...	...	...	...	...	...	...	...	2
273	1	1	...	...	...	...	...	...	...	...	...	...	...	...	2
274	6	1	...	...	...	...	...	...	...	1	...	...	...	...	8
275	2	1	...	...	...	...	...	...	...	...	...	...	...	...	3
276	3	...	1	1	...	...	...	...	...	...	...	...	...	...	5
278	1	...	...	...	...	...	...	...	...	...	...	...	...	...	1
280	2	...	...	...	...	...	1	...	...	...	...	...	...	...	3
281	...	...	...	...	...	...	1	...	1	...	...	...	...	...	2
283	...	...	...	...	...	...	...	...	1	...	...	1	...	...	2
284	...	...	...	1	...	...	1	...	...	...	...	...	...	...	2
286	...	...	...	...	...	...	...	...	1	...	...	...	...	1	2
287	1	...	...	...	...	...	1	1	...	...	...	...	1	...	4
288	...	...	...	...	...	...	1	...	...	...	...	...	...	...	1
289	...	...	...	...	...	...	1	...	...	...	...	...	...	...	1
291	...	...	...	...	1	...	1	...	...	...	...	...	...	...	2
296	1	...	...	...	...	1	...	...	...	...	1	...	...	...	3
	25	5	3	4	1	1	7	1	3	1	1	1	1	1	55

Average, 276 days.

(*g*) Dr. Reid, Lancet, 1850, vol. ii.; Raciborski, De la Puberté, etc., p. 460; Rigby, System of Midwifery, p. 84; Lockwood, Am. Journ. Dec. 1847; Beatty, Dub. Med. Journ. vol. viii.; McIlvaine, Am. Journ. 1848; Montgomery, Signs of Pregnancy; Desormeaux, Dict. de Med. vol. x.; Merriman, S. W. J., Taylor's Med. Jur., Am. ed., p. 399; Girdwood, Lancet, Dec. 1844; Skey; Anderson *v.* Whittaker (in Dr. Reid's Paper, loc. cit.); Lee, Med. Gaz. 1831; Dewees, Midwifery.

§ 56. In the last edition of Dr. Montgomery's work above referred to, he furnishes a table of the duration of pregnancy in fifty-six cases "in which the day of fruitful intercourse was known." We have calculated the average duration of pregnancy in these cases and find it to be nearly 276 days, a result which agrees with and confirms that of the table already given. It does not differ materially from the conclusions of Elsässer from an analysis of 260 cases.(g^1) But it is most important to bear in mind that the average number of days of gestation in any series of cases by no means represents the duration of the greater number of those very cases. For while in the table above given 276 is the average number of days of gestation, five cases only terminated on the 276th day, eight did so on the 274th day, four on the 287th, etc.

§ 57. M. Aubinais(g^2) relates the following, which certainly militates against the views of those who maintain the occurrence of prolonged gestation. Two sisters, of irreproachable virtue, were married to sailors on the same day. The husbands were ordered away to join their ships the next morning at 6 A.M. On the 264th day following, both sisters were brought to bed at almost the same hour.

The result yielded by the foregoing table brings down the average duration of pregnancy much below the exaggerated estimate of some authors, below even the conceded average of many accoucheurs, but places it in remarkable harmony with the prevailing popular and medical belief. Two hundred and seventy-six days are included in nine calendar months; and, according to these calculations, represent the average duration of pregnancy from a single sexual act.

§ 58. Such appears to be the only result attainable at the present time. Without giving positive certainty to our knowledge respecting the law governing the duration of pregnancy, it renders the probability of error in other modes of investigation than that based upon the foregoing principles stronger than it can by any arguments be made to appear. In other words, it proves that the *apparent* variation in the

(g^1) Henke's Zeitschrift, lxxiii. 394.

(g^2) Phila. Med. Times, vol. i. p. 147, from Journ. de Méd. et de Chirurg.

length of the term is greater than the *actual*. Although not affording us any reason to consider the normal period to be a fixed one, from which there is really no departure, it nevertheless reduces the excess within reasonable bounds.

§ 59. That a deviation from the normal period is possible, is evident not only from the instance we have quoted, but is also sustained by observations upon certain domestic animals. Even here it is necessary to premise that there are sources of fallacy. The analogy between the functions of menstruation in the female, and the period of sexual excitement in the cow, mare, etc., is far from being well established, although some late authors have assiduously endeavored to maintain that it is real. Hence the entire impossibility of knowing when conception occurs in them. Moreover, some of these animals will not refuse the male, although already pregnant, and therefore the origin of the pregnancy may not be dated far enough back. This is the case with the cow.

§ 60. Prof. Krahmer,(*h*) whose observations we cite below, gives examples of this. Thus, "No. 105" took the bull on the 2d of May and on the 23d November, 1815; she calved on the 17th of February, 1816; *i. e.*, 296 days from the first covering, and 86 days from the second. "No. 42" took the bull the 30th November, 1808, and again 31st March, 1809; she calved 7th September, 1809; *i.e.*, 281 days after first, and 160 days after second covering. Another case is mentioned in which a cow was slaughtered on account of this propensity, and was then found to have been some time with calf.

Lord Spencer(*i*) published, some years since, the result of seven hundred and sixty-four instances of the gestation of cows. The average term he found to be 285 days. Three hundred and fourteen cows calved before the 284th day, and three hundred and ten after the 285th. At 284 days, sixty-six calved; and at 285 days, seventy-four. Few cases exceeded the period of 285 days more than five or eight days; eight only exceeded it by more than twelve days; and one only went

(*h*) Beitärge zur Lehre von der Schwangerschaftsdauer, Henke's Zeitschrift, 1849, I. II. p 98.

(*i*) Journal of the Agricultural Society, as quoted by Reid, Beck, and others.

to the eighteenth day beyond it. According to M. Tessier's observations, the excess above the average period, in one hundred and two mares and one hundred and sixty cows, was from fifty-seven to sixty days in the former, and thirty-two to thirty-five in the latter.

§ 61. The most recent and extensive researches on this subject are those of Professor Krahmer, of Halle. His observations were made on sheep and cows. Every precaution was taken to insure accuracy, each individual in the flock or herd having been marked when heat appeared, then separated therefrom and allowed access to the male. The days of covering and of the birth of the young were registered. Among the sheep, the birth fell on the following days:—

2	fell on the	145th	day.	7	fell on the	153d	day.
3	"	146th	"	3	"	154th	"
11	"	147th	"	1	"	155th	"
14	"	148th	"	1	"	159th	"
38	"	149th	"	1	"	166th	"
44	"	150th	"	1	"	168th	"
31	"	151st	"	1	"	169th	"
18	"	152d	"	1	"	171st	"

If the average of these 177 births be calculated, it will be found to be 150, and yet only one-fourth of the whole number really fell on the 150th day. Thus the probability appears to be, that of four ewes only one will drop her lamb at what may be considered the normal term of gestation in the sheep.

§ 62. The whole number of cows observed was 1105: the observations covering a space of twenty-six years, viz., from 1808 to 1832, and including fifty-five in 1847. The average duration is stated at 282 days; but the tables of Dr. Krahmer include no less than forty-six births before the 260th day, which ought certainly to be looked upon as premature. Leaving these aside, the average would probably be increased by a day or two. Stated in weeks, and neglecting forty-six births before the 38th week:—

12	cows calved in the	38th	week.	21	cows calved in the	44th	week.
72	" "	"	39th "	9	" "	"	45th "
335	" "	"	40th "	3	" "	"	46th "
429	" "	"	41st "	5	" "	"	47th "
135	" "	"	42d "	4	" "	"	48th "
33	" "	"	43d "	1	" "	"	51st "

§ 63. If the argument from analogy be admissible, the fact may be considered as well established, that pregnancy is a condition which may occasionally exceed the normal limit for its duration; but the limit to this excess cannot, in the present state of physiological science, be accurately known. It is undeniable, however, that the greater the amount of deviation the more authentic and convincing should be the proof required of its actual protraction. The suggestion has, indeed, been made, that the development of the child might afford a key to the extent of the protraction; but facts derived from this source rather militate against than for its reality. In most of the cases in which a child is supposed to have been carried beyond the usual period, it has not attained a greater size than is met with in ordinary cases. Sometimes, indeed, it has been rather smaller than the average. If we could admit that pregnancy ever attained the period of twelve, fourteen, or sixteen months, as has been asserted, there is no reason why the child should not have continued to grow to a size incompatible with its being born alive. The supposition, that after nine months it ceases to grow, is an assumption unwarranted by analogy or reason, and put forward only with the hope of maintaining a foregone conclusion.

§ 64. While, therefore, we admit the occasional prolongation of pregnancy beyond its usual limit of 276 days, to the extent of perhaps four weeks, we cannot venture, with such fallacious evidence as often serves as the basis of the calculation, to accept, as authentic, those instances in which it has apparently been prolonged beyond this time. The following case quoted by Dr. Reid, from Bartholin, will form a fitting conclusion to these remarks.

"A young girl of Leipsic, of doubtful character, accused a young man, who was rich, of having impregnated her. The magistrates acceded to the request of the friends of the accused, and had the girl confined in prison and kept under proper surveillance. She was not delivered until after the sixteenth month; but the fœtus was very small, and lived only two days, being imperfectly developed. This case was adduced as a very strong instance of protracted gestation, the young woman being so strictly watched by the keepers of the prison

as to preclude all chance of impregnation whilst there. The undeveloped condition of the fœtus, however, is a sufficient proof against a sixteen months' gestation, and, as to the chance alluded to, we may simply ask—

'*Sed quis custodiet ipsos custodes?*' "

§ 65. We have endeavored, in this chapter, to show how far the actual duration of pregnancy is capable of *demonstration*, and have, therefore, forborne introducing into the discussion any arguments not based upon direct observation of the phenomena of gestation in man or animals. It is not unusual, however, with writers in discussing this subject to allege, in proof of the really variable and uncertain limit of this process, that nature is never restricted in her operations within precise and well-defined limits. This argument is presented with great clearness in the following pages, containing Judge Lewis's opinion in the case of Com. *v.* Hoover. We cannot, however, refrain from reiterating the opinion that the seeming analogies of nature cannot for a moment be adduced in opposition to the facts of physiological science.

§ 66. 3d. *Legal decisions.*—The following decision on the duration of pregnancy deserves especial weight from the character of the learned Chief Justice of Pennsylvania, by whom it is reported as well as decided.

At a special Court of Quarter Sessions of Lycoming County, at which Judge Lewis presided, the following instructions were given in reference to the count for fornication and bastardy: "If you believe, from the testimony of John Reibsam, that the prosecutrix had submitted to improper connection with the witness, *about the time when the child was begotten, this circumstance destroys her competency as a witness to prove that the defendant is the father of her child.* The organs of conception, like those of digestion, perform their appropriate offices, without the volition of the female. She is not conscious, at the moment of the occurrence, of what takes place. It is only by *inference* that she can afterwards fix the paternity of her offspring. If her intercourse has been confined to *one* individual, there is no difficulty in drawing a correct conclusion from the premises. But, if she has exposed herself to the em-

braces of several, at or about the time she became pregnant, she has placed it out of her power to draw any safe conclusions on the subject. Where two causes are shown to exist, either of which is adequate to produce the effect, and there are no circumstances to determine the mind in favor of either, the cause must necessarily remain uncertain; and in that case there is not sufficient evidence to justify a conviction."(*j*) In trials for this offence, the defence is frequently rested upon the period of time which elapses between the alleged criminal connection and the birth of the child, in cases of material departures from the usual period. In a case of this description, Com. *v.* Hoover, the President of the Court of Quarter Sessions of Lancaster County (Lewis) gave the following charge to the jury: Com. *v.* Elisha F. Hoover. "The defendant is indicted for fornication and bastardy. The prosecutrix, Catherine E. Rife, is a competent witness, but her credibility is for the jury. According to her account, the child was begotten on the 23d of March, 1845. It was born on the 30th of January, 1846; a male, fine, large, and healthy. The period of gestation was 313 days. It is conceded that the defendant had no intercourse with the mother after the 23d of March, 1845, and the time of delivery is fixed with equal certainty. A question of science has arisen, respecting the possibility of protracted gestation. The usual period is nine calendar months, or 273 or 275 days. What has been denominated the *extreme* of the *usual period* is 280 days, or ten lunar months. But whether any, and, if any, what longer time may be allowed as possible, are the questions which this case presents for decision. Medical writers of celebrity and authority are arrayed on both sides of these questions. And the medical witnesses upon the stand are in like manner divided in opinion. In constructing this evidence, so far as respects the *facts* narrated by each, it is proper to consider that writers and witnesses are respectively relating only the results of their own knowledge; and when one states that no case of protracted gestation has fallen under his observation, it is but negative testimony, and cannot justly be relied upon to invalidate the negative evidence of others, equally entitled to credit,

(*j*) Com. *v.* McCarty, 3 Penn. L Journ., p. 140.

who enumerate cases of the kind, which they positively affirm to have come within the range of their practice and knowledge. In the most familiar transactions of life, witnesses will differ in their narration of circumstances. In narrating a simple assault and battery, the bystanders frequently vary in their statement of the facts. Some narrate incidents which others omit. Conceding all the witnesses to be equally worthy of credit, the rule is to reconcile their evidence so that all will stand consistently together, if this be reasonably practicable. Some witnesses observe circumstances which others have not seen. Negative evidence is therefore deemed insufficient to outweigh affirmative statements from witnesses equally entitled to credit. One gentleman, in a very long course of practice, may have failed to observe any case of the kind. Another, in a very brief period, may have noticed several. And it is reasonable to believe that where such a diversity of opinion exists, each will be in some measure influenced by his own professional experience, and that this will also, to some extent, affect his belief in the cases reported by others. There are, doubtless, many of these cases where the struggle for character and property, and the circumstances of the parties whose interests have been involved, have furnished temptations to falsify, and may have influenced the decisions of the tribunals. But, after making all proper allowances for cases of this description, the whole evidence on the question, when fairly considered, appears to show that cases of protracted gestation are not impossible, although their existence is very unusual. The heads of wheat in the same field do not all ripen together. The ears of corn on the same stalk do not all come to maturity at the same time. Even the grains of corn on the same ear ripen at different periods. The fruit on the same tree shows a like deviation. A portion will ripen and fall, while other portions remain comparatively green upon the parent stalk. The eggs of the fowl, under process of incubation at the same time, are subject to the same variation. In quadrupeds, if the testimony of M. Teissier be believed, we have proof of the like irregularity. Whatever may be the causes operating in each case to divert nature from her accustomed course, to accelerate or delay her usual progress, the human species, like the rest of

creation, seem occasionally under their influences. The developments of puberty, although generally shown at a certain age, are far from regular. Some individuals approach it earlier, others later in life. Intellectual maturity is subject to like irregularities. Some are precocious, others astonishingly tardy in arriving at the usual degree of discretion. The intervals between the catamenial visits, although in general regular and fixed, exhibit remarkable deviations. Their final departures, although generally to be expected at a certain age, are as irregular as their first approaches, and as subject to variations as were their periodical returns. A certain period of life has been usually assigned for the terminations of a mother's perils, but the instances of extensive deviations from this general rule are numerous and well established. The gestation of one child at a time is according to the usual course of nature, but the birth of twins, triplets, etc., furnish indubitable proofs of astonishing departures from the usual course. The sensations of the mother, produced by the elevation of the fœtus from the cavity of the pelvis (called quickening), although usually occurring at a certain period, are known to be subject to the like departure from the usual time. It has been said that human life does not generally extend beyond seventy years. But if this be the general rule, the departures are numerous. The most distinguished jurist perhaps now living in the whole world (Chancellor Kent) will be eighty-three years old on the first of July next; and yet, within a few days, I have been honored by the receipt of a letter from him, under the date of the 18th instant, in which he states that he is still in good and active health, that his relish and ardor for studies and legal learning continue unabated, that he has the blessing of good eyes, and that he is still an observer of what passes with lively sensibility. This instance may serve to illustrate not only the occasional deviations from the general rules respecting the duration of human life, but the like variation in respect to intellectual vigor, by which one individual attains a pre-eminence over the generality of mankind. All nature abounds with occasional departures from her general customs. Even the compass, which guides the mariner on the trackless ocean, which enables science to fix with reasonable certainty

the boundaries of kingdoms and farms, and the truthfulness of which to its accustomed law has been perpetuated by a proverb, is subject to mysterious but acknowledged variations. From analogy, and from the statements of distinguished authors and eminent witnesses, after making every allowance for mistakes and the operation of unfavorable influences, we are led to the belief that although nature delights in adherence to her general usages, she is occasionally retarded in her progress, and otherwise coerced, by causes not always apparent, into extensive deviations from her accustomed path. And we are induced to believe that protracted gestation for the period of 313 days, although *unusual* and *improbable*, is not *impossible*. The evidence to establish the existence of such a considerable departure from the usual period should be clear, and free from doubt. The witness should possess a character beyond reproach, and her testimony should be consistent and uncontradicted in all material facts. If the jury are satisfied that the evidence for the commonwealth is of this character, the unusually long period of gestation does not require them to disregard it. The law fixes no period as the *ultimum tempus pariendi*. The *usual* period has been stated, but longer time may be allowed, according to the opinions of the physicians and the circumstances of the case. The question is, therefore, open for the decision of the jury. If they believe the witness, they may find the defendant guilty." The jury found the defendant guilty. The prosecution was conducted by Messrs. Frazer and Mathiot, and the defence by Mr. Stevens. The case is fully reported in the *American Journal of the Medical Sciences*, No. 24, new series, Oct. 1846, p. 535, accompanied with a communication from Professor Atlee, in which he mentions two cases within his own practice where the period of gestation was about a year.(*k*) This latter period has received the sanction of the legislature of Pennsylvania as the longest period of indulgence which the law allows to a married woman who has a child in the absence of her husband. If she cannot show that he was in her company, or was within the colonies between the easternmost parts of New England and the

(*k*) Amer. Journ. of the Med. Sciences, Oct. 1846, p. 535.

southernmost parts of North Carolina, within twelve months next before the birth of the child, she is deemed an *adulteress* under the 4th section of the act of 1705.

§ 67. 4th. *Early viability.*—From the uncertainty which attends the establishment of the date of conception, and from the unequal development of the fœtus in different cases at different periods of gestation, the difficulty of knowing the actual age of an immature child is often very great. When born at the eighth month, the weight and size do not differ materially from what is often met with at maturity, but yet there are marks of imperfect development which are generally conclusive as to its immaturity, and which enable us to judge that but a few weeks were wanting to complete the development. (*Vide* ABORTION.) Thus, at the *eighth* month its length is only two or three inches, and its weight one to two pounds below the average. The pupillary membrane has disappeared, the testicles are found in the internal abdominal ring, and the middle point of the body is nearer the umbilicus than the sternum. In the fœtus, at *seven* months, however, the length hardly exceeds a foot, nor its weight four pounds. Children born at this age are often reared, if they have not been neglected. There can be no possibility of mistaking a fœtus of seven months for a mature child, while this error might readily be made with one at eight months.

§ 68. The most important epochs, however, relative to questions of viability and paternity are the *fifth* and *sixth* months. A great discrepancy will be found in the statements of authors as to the weight and length of the fœtus in these months. The weight of a six months' fœtus is, for example, set down by Burns, Hamilton, and Devergie at one pound, and by Maygrier at two pounds; while the last-mentioned writer states its length to be twelve inches, the others make it from eight to ten inches. The length of a five months' fœtus is usually considered to be from six to seven inches, but Maygrier and Sömmering allow as much as ten inches. In forming an opinion, therefore, as to the exact age of a child between the fifth and seventh month of uterine life, this variation in the estimates, by different authors, should inspire caution and reserve. It is better to acknowledge the impossibility of certifying the exact age,

than to attempt to give precision to a point incapable of receiving it.

§ 69. The period mentioned may be regarded as the debatable ground relative to the viability of the child. Mr. Whitehead says, that when abortion takes place before the *end* of the *sixth* month, it is invariably fatal to the offspring, either before birth or in a short time after, and at any period before the completion of the full term, it is more or less injurious to its well-being. Instances are, however, on record which disprove the correctness of this statement. Dr. Erbkam, of Berlin, has reported a case in which a fœtus only six inches long, and weighing eight ounces, was born alive, and survived half an hour. It moved its arms and legs, turned its head from side to side, and opened its mouth. The action of the heart continued after all other movements had ceased. The child was shown to the celebrated Müller, who expressed the opinion that it was not more than *four* months old.(*l*) A case, which is remarkable, and of great interest, on account of the accuracy with which the date of impregnation, and therefore the true age of the child, was ascertained, is reported by Dr. Barrows, of Hartford. Mrs. J—— miscarried on the 18th of May; her lochial discharges were profuse and long continued. Dr. B. was called to prescribe for her on the 18th of June, when she had increased vaginal discharge, probably the menstrual flow; this continued for a week or two, before it wholly subsided. She went from home, on the 27th of June, to spend some days in the country, and at this time, she first indulged in sexual intercourse subsequent to her miscarriage. On the 18th of November, in consequence of over-exertion, she again miscarried. Dr. Barrows attended her on this, as on the previous occasion. The ovum was expelled entire. The sac contained at least two pints of fluid. "The membranes were not ruptured for some little time, during which the movements of the child were active and vigorous. On rupturing the membranes, and exposing the child to the air, it instantly gasped, or, perhaps I ought rather to say, uttered a cry so loud as to be heard distinctly at a distance of several feet, it being at the same time

(*l*) Am. Journ. Med. Sci., 1838, p. 244.

covered with the bedclothes. The cord was tied on its ceasing to pulsate, at the end of two or three minutes, then separated, and the child wrapped in warm flannels. As it continued to manifest the ordinary appearances of life, its condition was watched with much interest and care. It breathed with a kind of convulsive gasp at intervals of one or two minutes, for a period of forty minutes. The heart beat regularly for forty-five minutes. . . . . The child repeatedly opened its mouth, and thrust forward its tongue." It measured (it was a female) *ten* inches in length, and weighed *fourteen* ounces. The integuments were, for the most part, firm and of a light color; the portion covering the abdomen was thin, and of a reddish hue. The hair of the head was like down, the rudiments of the nails were plainly discernible, and the iris was entirely closed by the *membrana pupillaris*. The head was tolerably firm, but the frontal and parietal bones were imperfect, and widely separated.(*m*) Dating from the first intercourse after the previous miscarriage, the age of this child was 144 days, or less than five calendar months. There is nothing in its size, weight, and development, as reported, inconsistent with the mother's reckoning and the facts related by her physician.

§ 70. Another case, in which a living child was born on the 179th day, is interesting from the fact that the child lived four months, and then died of an epidemic disease. When born, it was so feeble that it was not thought possible that it could live. Its cry could be heard only at a few yards' distance; it had no nails, its hair was downy, its skin florid and thin, and its extremities imperfectly developed. The bones of the head were soft and easily compressed, and the sutures wide. The pupillary membranes were entire. It was placed near the fire, in a basket, wrapped in soft cotton. It could not suck, but milk was dropped into its mouth through a quill. Forty days after birth it was found to be thirteen inches long, and weighed three pounds. The centre of the body was nearly an inch above the umbilicus.(*n*) A somewhat similar case, is that of Dr. Barker, of Dumfries, in which the child was born on the

(*m*) Am. Journ. Med. Sci., April, 1853, p. 380.
(*n*) Lancet, April, 1852.

158th day of gestation; it weighed one pound, and measured eleven inches. Three years and a half afterwards it was still living, and weighed twenty-nine pounds and a half.(*o*)

§ 71. In the case related in great detail by d'Outrepont, of Bamberg, a child which was not more than twenty-seven weeks, or six months old, when it was born, was still living at the age of eleven years. It was not larger at that time, however, than a boy of eight years.(*p*) Another curious instance, in which the life of a very premature child was preserved, is narrated by Dr. Rodman, of Paisley. The child's uterine age could not have been more than five months, since, three weeks after birth, it weighed only one pound thirteen ounces, and measured between eleven and thirteen inches. It survived its birth one year and nine months.(*q*)

§ 72. Nothing need be said upon the possibility of premature development, except that it is not sustained by any authentic facts, and that it is disproved by daily experience, which shows that the fœtal development is regular and progressive, except when retarded or arrested by disease. That a child can anticipate, as it were, its maturity, acquiring, *e. g.*, at six or seven months the development it obtains usually only at nine, is far more difficult to credit than that the mother or her physician should be mistaken in their reckoning. In our remarks upon protracted gestation, we have exposed the difficulty, not to say impossibility, of fixing the date of fruitful intercourse or of conception, and the mistakes which the female is apt to commit by the ordinary manner of calculating the duration of pregnancy. Those remarks are equally applicable here, and perhaps, indeed, more so; for if it is rare to find the child at the close of a seemingly protracted pregnancy overmature, it is still more contrary to experience that a fœtus should be a month or more further advanced in its development than belongs to the period of uterine life which it has reached.

It is sometimes of importance to determine the momentary life of the child, even although the possibility of its surviving

(*o*) Med. Times, Sept. and Oct. 1850.
(*p*) Henke, Zeitschrift, vol. vi.
(*q*) Guy's Med. Jur., p. 180.

is out of the question. The question as to *what constitutes live birth*, although of less importance at this time than at the natural term of gestation, has, nevertheless, some bearing upon civil rights and relations. Every spontaneous movement is an evidence of life. To what degree these must be carried, to constitute evidence of life before a court of law, it is not for us to determine. The following case will serve, however, to show that a child may be born alive, in this sense, in the fourth month: A fœtus was born which weighed exactly nine and a half ounces, and measured eight inches in length. On touching the feet and hands, the limbs were immediately drawn up and moved about. On blowing on the face, the lower part of it was tremulously moved, and the mouth at each time opened, and three or four times an attempt to respire or gasp, accompanied by an apparently respiratory movement of the chest, took place. The pulsations of the heart through the thin walls of the chest could be readily observed. After the umbilical cord was cut, these movements became more feeble, and soon ceased. On opening the chest, the situation and appearance of the lungs and other organs were characteristic of its apparent age. The lungs, in color and volume, resembled those of an early fœtus; and, with the exception of one or two ecchymosed spots, no color or other evidence of developed air-cells were noticed, all the appearances indicating that no air whatever had ever reached the tissue of the lungs. The brain was afterwards minutely examined, and also found to be characteristic of the apparent age, as were also the other fœtal organs. The calculations of the mother corresponded with the age given to the fœtus.(*r*)

(*r*) Dr. Keiller. Read before the Edinburgh Obstetrical Society. Ed. Month. Journ., Sept. 1854.

CHAPTER IV.

SUPERFŒTATION.

§ 73. CONCEPTION during pregnancy is termed superfœtation. The early physicians accorded a ready belief to its frequent occurrence; but modern inquiries have led to a more precise and restricted application of the term. There are cases of apparent and of real superfœtation. They may all be conveniently considered under the following divisions:—

1st. Twin pregnancies in which the children, by certain physical peculiarities, prove that they have had different fathers.

2d. Parturition of children nearly at the same time, but differing much in the degree of their development.

3d. After the birth of a mature child, a second one equally mature is born, after an interval which may amount to four months.

1st. Under the first division may be ranged all those cases, of which now a great number have been recorded, where women have given birth to twins of different colors. In some of these the fact of cohabitation at short intervals with men of different colors was admitted by the woman. A case, very frequently quoted, is that related by Buffon, as having occurred in South Carolina, in which a white and a mulatto child were born to a white woman, who, immediately after having had commerce with her husband, was obliged to receive the embraces of a negro. A similar case is related by Dr. Lopez, in which the mother was a negro woman, and the twins were, the one black and the other mulatto.(*s*) Dr. Tyler Smith refers to a case occurring in the Brazils, where the indigenous race

(*s*) Am. Journ. Med. Sci., Oct. 1845, p. 315. For a large number of similar cases, *vide* references in Beck's Med. Jurisprudence, i. 265; also a case by Dr. Carter, of Va., in Phil. Med. Ex., 1849, p. 523, and another by Dr. A. F. Attaway, of Geo., Am. Journ. Med. Sci., July, 1854, p. 290.

is copper-colored, but where there are negroes and whites, in which a creole woman had three children at a birth, of three different colors, white, brown, and black, with all the features of the several races.(*s*[1])

§ 74. The same fact has been observed in animals. Mende relates that a mare, which had been covered by a stallion, and shortly afterwards by an ass, produced at the same birth both a horse and a mule. Dr. Read, of Andover, reports a similar case, except that the mare was covered by the horse two or three days after the ass.

§ 75. Up to what period, after one conception, a second impregnation is possible, cannot, in the present unsettled state of our knowledge respecting the early phenomena of fecundation, be determined with exactness. While some eminent physiologists continue to maintain that the ovum is fecundated in the ovary itself, more recent researches tend to show that it takes place, in normal cases, in the uterus or in the Fallopian tubes, the ova being detached at the menstrual periods, and finding their way to the womb, independent of fecundation. It will be readily seen, therefore, how many questions must be answered before this one can be solved. In addition, the period at which the deciduous membrane is formed in the uterus is not known with sufficient precision to enable us to judge how soon an efficient obstacle is placed against the penetration of the seminal fluid into the uterus, or to an additional impregnation. Dr. J. M. Duncan denies that the plug of viscid mucus in the cervix of the uterus during the early stage of pregnancy, is a sufficient barrier against a second impregnation, as he has found it in the non-menstruating *unimpregnated* uterus. He does not, however, prove that in the latter case impregnation can take place. He also is led to believe, from an inspection of an ovum *in situ* of about eight weeks, that sufficient space exists between the decidua vera and reflexa at this time, and an open communication to the Fallopian tube, to permit impregnation. He believes that the decidua is formed by the development of the normal mucous membrane

(*s*[1]) Lancet, April, 1856, p. 388.

of the uterus, without closing the tubes or the cervix uteri.(*t*) This was the doctrine of William Hunter, and it has received the weighty sanction of Dr. Tyler Smith. In all the known cases of undoubted superfœtation, such as those above cited and referred to, the time which intervened between the separate acts of coition was very short; in fact, where the circumstance has been confessed by the woman, it appears that one sexual act followed almost immediately upon the other. In a case related by Mosely,(*u*) a negress brought forth two children at a birth, one a negro, the other a mulatto. She confessed that a white man on the estate came to her hut one morning before she had risen, and she suffered his embraces, *almost instantly* after her black husband had quitted her. In another in which the children were the one black and the other mulatto, the negro mother admitted having cohabited *during the same night* with a negro and an European.(*v*)

§ 76. A case of superfœtation by Dr. Taylor, of Miss., forms an exception apparently to the rule. Here a negress brought forth at one birth a black and a mulatto child. The latter appeared to be "three weeks younger than the negro," but as the woman admitted having cohabited with a white man one week after the cessation of the catamenia, and upon a *night succeeding* an act of intercourse with her husband, the case cannot, we think, be viewed differently from the preceding.(*w*) The same may be said of Dr. Attaway's case, before referred to; but in this the date of the conception of the white child might have been nearer that of the negro than three days—the interval assigned by the woman.

§ 77. 2d and 3d. The cases of *apparent* and pseudo-superfœtation may be embraced in the second and third divisions, which will here be considered together. They are all of them explicable upon the supposition of unequal development of twins; this inequality being due often to some natural defect in one placenta or one fœtus, but frequently also to a direct compression exercised by one child upon the other. In cases

(*t*) Ed. Month. Journ., April, 1853.
(*u*) Diseases of Trop. Climates, p. 111.
(*v*) Casper's Wochenschrift, Jan. 8, 1842.
(*w*) Am. Journ. Med. Sci., April, 1849, p. 549.

where this compression has been so great as to cause the death of one fœtus, it may be easily recognized after birth by the appearance of the body. Thus, in a case referred to by Dr. Beck,(*x*) Mr. Ingleby says: "A few weeks ago, on examining a mature placenta, the expulsion of which was attended with severe hemorrhage, a fœtus of four or five months, flattened but not putrid, was found within the membranes, closely adherent to the uterine surface of the mass, and yet a full-sized living child, in connection with this placenta, had just been expelled." Duvernoy(*y*) also relates an instance in which the mother gave birth to a living female child, healthy and mature, and immediately afterwards to a dead fœtus of about six months, with its head and face extremely flattened and deformed. Pouchet(*z*) gives the history of a most interesting case communicated to him by Dr. Merrielle. A lady was delivered of a healthy and mature female child, which was soon followed by the placenta. Her labor-pains continued notwithstanding, and the next morning she expelled an entire ovum, containing another fœtus. This fœtus presented all the characters of a child of four months; it was seven inches long. Almost every part of its body bore evident traces of compression. Its head was flattened transversely to such a degree, that the sinciput presented a sharp edge, and at the temporal region its diameter was not more than six lines. The chest was also very much compressed. The upper extremities, and particularly the left hand, were greatly flattened. The appearance of the skin showed that the fœtus had been a long while dead. It was of a pale brown color, and denuded of epidermis over a great part of the body. Dr. Streeter related a case to the Westminster Medical Society, in which one fœtus was alive at full term, and the other blighted, having apparently perished at the third month. It had undergone very little decomposition, and was squeezed quite flat.(*a*) Dr. Perkins, of New London, in a letter to Dr. Porter, May 16, 1840, relates as follows: That he delivered a woman of a healthy male

(*x*) Med. Jur., i. p 269.
(*y*) Note sur une grossesse double parvenue à terme. Strasbourg, 1834.
(*z*) Théorie positive de l'ovulation spontanée. Paris, 1847.
(*a*) Lancet, Oct. 30, 1841.

child, at full term. The same night she expelled a fœtus enveloped in its membranes, between four and five months old, entirely undecomposed and uninjured, except the head, which was compressed.(*b*) Dr. Lopez presented to the Medical Society of Mobile a specimen of a blighted fœtus of the third month, discharged with a living child at full term. The skull was so completely compressed, that the opposite parietal surfaces were in close contact. The whole body, in fact, was distorted and flattened by the pressure exercised by the other child upon it. It was not at all decomposed.(*c*)

§ 78. Having thus seen the compression which one fœtus in a twin pregnancy may exercise upon the other, it is not difficult to understand that the pressure may be sufficient to retard its growth without actually destroying its existence. If this compression becomes at a certain period so great, that without destroying the vitality of the fœtus, it only permits the blood to reach it in an insufficient degree, one twin becomes arrested in its development, while the other goes on increasing until its maturity, when it is expelled. The remaining fœtus, now relieved from the compression, grows with facility, and is born in its turn when it has reached maturity. If, for example, a fœtus, in consequence of the compression of the placenta, have at nine months a no greater development than is usual at five, it follows that after the birth of its fellow it must remain four months longer in the womb. Where the placenta is common to the two children, this cannot, of course, occur, since the birth of one child would render the intra-uterine existence of the other impossible.(*d*) Among the more remarkable cases illustrating the unequal development of twins, may be mentioned that communicated to Foderé by Desgranges, at Lyons, relative to the wife of Raymond Villard.

(*b*) Lopez, Am. Journ., Oct. 1846, where other cases will also be found illustrative of this fact. Dr. J. B. Davis gives a case of the unequal development of fœtuses in the same uterus. A woman, seven months advanced in pregnancy, miscarried with twins; one was of seven months' growth, the other of not more than as many weeks. Ohio Med. and Surg. Journ., Sept. 1850. Another case in N. W. Med. and Surg. Journ., Nov. 1850, and another in the New Orleans Med. and Surg. Journ., Sept. 1850. Consult also Montgomery, op. cit., art. Secondary Ovum.

(*c*) Loc. cit.

(*d*) *Vide* Pouchet, loc. cit.

She was delivered, on the 20th of January, 1780, of a living seven months' child; but the delivery was not accompanied with the usual symptoms: no milk appeared; the lochia were wanting, and the abdomen did not diminish in size. Three weeks after the delivery, she felt the movement of the fœtus, and on the 6th of July, 1780 (five months and sixteen days after the first birth), she was again delivered of a living female child. The milk now appeared, and she was enabled to nurse her offspring.(*e*) There was an interval of one month in the birth of two mature children in a case related by Dr. Irvine.(*f*) In another case, a woman, 35 years of age, was confined on the night of the 30th of March, 1848. The placenta came away without difficulty. The size of the abdomen remained very considerable; the lochia did not flow, and nevertheless the surgeon did not conceive the possibility of another child. Dr. Prival, of Bedarrieux, was called in and at once ascertained the presence of a second child. The one already born was full-sized, healthy, and took the breast with avidity. The mother would not remain in bed; she arose and occupied herself with her household cares. Twenty-one days after the birth of the first child, labor-pains again came on, and another child was born, as strong and healthy as the first.

§ 79. Instead, therefore, of attempting to explain those cases, in which, on account of the birth of mature children at an interval varying from a few days to several months, upon the hypothesis of superfœtation, it appears far more easy and rational to believe that they are examples of twin pregnancy, in which one fœtus has grown at the expense, as it were, of the other, and is first expelled; the second remaining until it has acquired the necessary maturity. Conclusive evidence of the fact of compression is afforded in those cases of double monsters in which the fœtuses differ considerably in size. Such an one, it is stated by Dr. Duncan, exists in his pathological collection.(*g*)

(*e*) Foderé, vol. i. 484. (*f*) Med. Times, Dec. 28, 1844.

(*g*) Am. Journ., July, 1849, p. 247, from Med. Times, May 26. For other cases, *vide* Med. Times, Dec. 1844; Henke's Zeitschrift, 1837—case by Dr. Möbus; Beck's Med. Jur., i. p. 266. A similar case, with the exception that

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§ 80. It has been suggested by various authors that superfœtation can be explained upon the supposition that the uterus was double; but although not a few instances of double uteri are on record, yet, in all, pregnancy, where it existed, occurred on one side only.(*h*) We have succeeded, however, in finding a remarkable case which has been hitherto strangely overlooked. A woman, native of Modena, became pregnant for the seventh time in 1817. Nine months afterwards, she was delivered of a male child, healthy and fully developed. The placenta was expelled and the woman recovered her health and strength entirely. Still, one-half of the abdomen remained enlarged, and the movements of a fœtus were distinctly ascertained. One month after her last labor, she was again confined of a living male child, also well formed. A few years after, she was again pregnant, and bore a child now living. This woman died afterwards of apoplexy. On examination, the uterus was found to be double, but with a single cervix;(*i*) hence this may have been either a case of real superfœtation —the children occupying each one horn of the uterus, and conceived at the interval of a month—or, on the other hand, it may have been really a twin pregnancy, but whether in the same or different cavities does not appear.

§ 81. The following are the conclusions of Casper upon this subject: 1. The great majority of all the cases of alleged superfœtation have their origin in fraud or in self-deception. 2. Very many of them are nothing more than twin pregnancies. 3. The occasional occurrence of a second conception within a

the second child was not born until forty days after the first, is reported in Month. Journ. of Med., Ed., Ap. 1855, from Gaz. des Hôpitaux, Dec. 1854.

(*h*) Dr. Oldham (in Guy's Hosp. Rep., vol. vi. p. 551) gives several instances, one of which is particularly remarkable, since not only the uterus, but the vagina also was double. "It was divided," he says, "by a septum of dense organized tissue, sufficiently loose and elastic to stretch without causing pain, so that both canals were equally capacious." The duplicity of the uterus was ascertained beyond a doubt. The woman was safely delivered. In the unimpregnated half, menstruation did not occur during pregnancy.

Another remarkable case of double uterus and vagina is reported by Dr. Kelly, of New York (Am. Journ., Oct. 1852, p. 328). He furnishes references, also to other cases.

(*i*) Encyclographie Médicale, Fev. 1849.

few days after a first cannot be rejected upon scientific grounds. 4. It is not to be believed that a new conception can take place in a female who is several weeks or months pregnant. 5. The possibility of a double pregnancy in a double uterus is not to be denied.(*a*) Prof. Kussmaul, of Heidelberg, who has thoroughly examined this subject, concludes that the condition of pregnancy offers no real hindrance to a second conception within the first two or three months. He holds, however, that true superfœtations, as the result of the fecundation of separate ova within different menstrual periods, if judged of by the cases that are recorded under this title, are simply examples of multiple conception, followed by the death or arrested growth of one or more of its products.(*b*)

§ 82. Schultze(*c*) draws a distinction between superfecundation, which he defines as the fecundation of several ova of the same ovulation period, and superfœtation, *i. e.*, the impregnation of a second ovum which left the ovary during an existing pregnancy. The first he regards as quite probable, as he denies that the os uteri is occluded by a mucous plug, and says that he has found living spermatozoa in the secretions of the vagina six days after the last coitus. On the other hand, while he admits the possibility of superfœtation, he contends that it has never been established by cases; and Kussmaul(*d*) considers that the cases reported are readily explicable in other ways.

§ 83. It may be necessary to state, that, where extra-uterine pregnancy takes place, the uterus may receive a new ovum. Mende(*j*) gives two cases of this kind, and Horn(*k*) relates a case of coexistent uterine and extra-uterine pregnancy, in which the woman was safely delivered of the child which was contained in the uterus.

(*a*) Gericht. Med., ii. 228.

(*b*) Brit. and For. Med. Chir. Rev., Jan. 1860, p. 113.

(*c*) Jenaisch Zeitung, 1865. N. Syd. Soc. Bien Retrospect, 65 and 66, p. 393.

(*d*) Deut. Zeitung, vol. xiii. part 2.

(*j*) Gericht. Med., p. 355.

(*k*) Siebold's Journ. für Geburtshülfe, 8 Bd. s. 330.

CHAPTER V.

ABORTION AND FŒTICIDE.

§ 84. 1st. *Natural causes.*—The *natural causes* of the premature expulsion of the fœtus from the womb are extremely numerous. They are found in certain morbid conditions of the system, either original or dependent upon pregnancy—in diseases of the ovum and its appendages, and in a class of causes usually called accidental, but which might, perhaps, in reference to the present subject, be termed *direct* or *immediate.* We refer our readers, for an enumeration of the predisposing causes of abortion, to those works on midwifery which treat directly and at length upon the subject. It is not our purpose to dwell upon them here. The consideration of them has, we conceive, but a slight bearing upon criminal cases, since the object in these is to ascertain the employment and mode of action of some medicinal substance, or culpable manœuvres, in reference to their tendency to produce the premature expulsion of the fœtus. In estimating the legal criminality of attempts to produce abortion, we should not, without sufficient grounds, impute the occurrence of this event to the designs and attempts of the accused party; for, however criminal the intention, if the means employed were wholly inadequate to fulfil it, there is no room for the intervention of the law. In this connection it should not be forgotten that abortion is an accident of common occurrence, to which many women are peculiarly subject, and which may depend upon disease of the placenta or fœtus, the death of the latter, syphilis, smallpox, or other constitutional disease of the mother, or which may be occasioned by various causes accidentally producing weakness, or, finally, which, relatively to the strength of the female, are violent and sufficient to bring on uterine contractions, although innocuous under ordinary circumstances. At the same time a natural tendency to abortion would not, we presume, mitigate the

criminality of the act of procuring it. In truth, abortion can rarely be designedly effected, unless by mechanical means, where there is not a predisposition to it; hence the violence and fatality of the measures which are sometimes used to accomplish it. The cases are, indeed, too familiar to be deserving of special record, in which, after the most violent bodily injuries, women have not aborted, but carried their children the full time and been safely delivered. Mr. Whitehead, for example, mentions the case of a poor woman, in the fourth month of pregnancy, who received a severe fracture of the skull, from a blow with a hatchet, for which she was under treatment nine weeks. She was delivered of a healthy child at the full term of utero-gestation.

§ 85. 2d. *Drugs.* (1) *Ergot.*—Most authors assert that there are no specific medicinal substances by which abortion can be produced. The only drug which has any claim to be considered as specific in its action upon the uterus is the *ergot of rye.* Some writers allege that it is only capable of increasing the energy of the uterine contractions when these have already begun, and deny to it the power of originating them. We need, however, in this place, only show that it has this power. Thus, Mr. Whitehead (who by no means favors the view of its specific character) states, that in a case under his care, where, owing to deformity of the pelvis, it was necessary to get rid of the fœtus in the fifth month of pregnancy, the ergot alone was employed, and at first with desired effect. It was given in three successive pregnancies, and in each instance labor-pains came on after eight or ten doses had been administered, and expulsion was effected by the end of the third day. Tried in a fourth pregnancy in the same person, it failed completely.(*l*) Hoffman has collected the experience of others with this substance. Out of forty-seven cases of premature labor in which the ergot was employed, it produced it, without the necessity of, or the employment of other means, in thirty-two, while, in the remaining fifteen cases, it was given in addition to other means.(*m*) Dr. Ramsbotham says:

(*l*) On the Causes and Treatment of Abortion and Sterility. Am. ed. 1848.
(*m*) Neue Zeitschrift für Geburtskunde, Bd. 23.

"*Egomet ipse tamen permulta vidi exempla, in quibus partus prematurus inductus fuit septimo vel octavo graviditatis mense peracto, solo secalis cornuti usu, ovuli membranis integris servatis, ore uteri occluso neque digito, neque ullo alio modo ad patefactionem excitato.*"(*n*) The same author has recently published a valuable paper on the induction of premature labor by the ergot, in which, we think, the reader will find conclusive evidence of the specific power of this drug. Premature labor was artificially induced by it in three successive pregnancies in one patient. A table of *fifty-five* cases is given in which it was successfully used.(*o*) Dr. Churchill says: "Ergot of rye is now pretty generally supposed to have the power of originating uterine contractions."(*p*) Much of the difference of opinion with respect to the uterine tendency of ergot depends no doubt upon the inertness of certain samples of the drug gathered at the wrong period, since it appears, upon good authority, that it should be collected during its stage of formation, being powerless afterwards. It is now well ascertained that, independently of its exciting uterine contractions, ergot directly affects the life of the fœtus by a depressing action upon the heart, and thus may indirectly become a cause of abortion. Instances of the sort are numerous during epidemics of *ergotism*, or the poisonous effects of ergot produced by eating bread made of flour containing this product.

§ 86. (2) *Savin and oil of tansy* are more frequently used than ergot. They have both unfortunately a popular reputation as emmenagogues and as agents for producing abortion. Whatever good effect their stimulant properties may have in cases of amenorrhœa dependent upon feeble development, it is very certain that they have no direct power of instituting uterine contractions. Their action as abortives is solely due to their poisonous properties, since when given in proper medicinal doses they are merely aromatic and stimulant, and may prove emmenagogue, without necessarily exciting uterine contractions. In fact, tansy is in common use as an agreeable

(*n*) Parturition. London, 1841. Appendix, p. 639.

(*o*) Med. Times, Jan. 1854.

(*p*) Syst. of Midwifery, p. 279. See also Shapter, Prov. Med. Journ., April, 1844.

bitter for promoting the appetite. We think, however, that the administration of either of these drugs to pregnant women should always be looked upon with suspicion, for we cannot imagine any condition which, at this time, would require or justify their employment. In a case in which probably from one to two ounces of the oil of savin had been swallowed, a most violent inflammation of the stomach was excited, followed by softening and perforation of this organ, peritonitis, and death. The uterus was empty; it was of the size usual at the third or fourth month of gestation, and, judging from the state of the parts and the lochial discharge, the fœtus had been expelled, it was supposed, from two to three days. Morphia and chloroform had both been taken by the unhappy woman, but the violent inflammatory results found at the post-mortem examination were, no doubt, properly ascribed to the action of the savin.(*q*)

§ 87. Dr. Lee states that he has known an instance where sixty drops of the oil of savin were taken every morning for a week, for the purpose of procuring abortion, in the sixth month of pregnancy. It brought on violent pain in the abdomen and region of the uterus, and the woman died on the third day after the delivery of a still-born fœtus; on dissection, the uterine organs as well as the pelvic viscera generally were found to be in a state of high inflammation. Another case is mentioned in which an infusion of savin was taken for a similar purpose. It brought on violent and incessant vomiting, extreme pain and uterine hemorrhage, and death in a few days.(*r*)

Dr. Taylor met with a case in which death was caused by powdered savin—abortion having first taken place. Eight ounces of green liquid were found in the stomach, which, with the œsophagus and the small intestines, was highly inflamed. The poison was identified by observing the minute portions of the leaves under the microscope.(*s*)

(*q*) Am. Journ. Med. Sci., April, 1851, p. 529. Communicated to Dr. T. R. Beck by James H. Salisbury, M. D., of Albany, N. Y.

(*r*) Copland's Med. Dict., Am. ed., art. "Abortion."

(*s*) Med. Gaz. xxxvi. 646.

§ 88. A case of poisoning with oil of tansy is reported by Dr. Dalton, of Boston, in which death, after the most violent convulsions, took place at the end of three hours and a half; the quantity swallowed was more than an ounce. The uterus contained a well-formed fœtus about four months old, and there was not the least appearance anywhere of the fœtus or membranes having suffered any disturbance.(*t*) In another fatal case of poisoning with this oil, reported by Dr. Hildreth, the quantity taken was half an ounce, and death followed in less than two hours. Pregnancy of a few weeks' standing existed, and the drug was, as in the former case, undoubtedly taken for the purpose of producing abortion, but nothing of the kind took place.(*u*)

§ 89. The leaves and unripe fruit of the common *rue*, most probably, act like the foregoing drugs, solely by their irritant properties, which have been used with the hope of procuring abortion. The only cases which we have met with, where this was successfully induced, are those reported by Dr. Hélie. The constitutional symptoms were, in them, very alarming, resembling such as are produced by poisons of a narcotico-acrid character.(*v*)

§ 90. Powerful purgative medicines, such as aloes, jalap, croton oil, and elaterium, given repeatedly, or in doses capable of setting up violent action of the lower bowels, may produce abortion by a secondary action upon the uterus. The same may be said of cantharides and turpentine. All of these drugs are capable of producing a great degree of active congestion and inflammation in the pelvic viscera, and hence the uterus is not always exempt from their action. At the same time, they can hardly produce this result without seriously endangering the mother's life. It is certain that in the greater number of cases, where abortives are criminally employed, the life of the mother is more readily sacrificed than that of her offspring.

§ 91. 3d. *Venesection* has seldom a tendency to produce abortion. On the contrary, there is no remedy more in vogue for warding off a threatened abortion than this, and numerous

(*t*) Am. Journ. Med. Sci., Jan. 1852, p. 140.
(*u*) Ibid., May, 1835. (*v*) Ann. d'Hyg. Pub., vol. xx. p. 120.

authors testify that pregnant women have been bled many times in succession without this result ensuing.

Nevertheless, when pushed to the extent of causing syncope it may have that effect. M. Dépaul(*w*) relates an instance in his own practice, where a woman, apparently suffering with severe headache, in two successive pregnancies, applied to him for the purpose of being bled. He afterwards discovered that the bleedings in these and on one previous occasion had destroyed the fœtus, and that he thus had ignorantly seconded the intentions of the mother. Suction of the nipples by the mouth or by cupping glasses has occasionally been resorted to for the production of premature labor.(*a*)

§ 92. 4th. *Mechanical means.*—In some instances the woman seeks to rid herself of her burden, by making use of violent exertion, by direct injury to the abdomen, or by the introduction of instruments into the womb. These attempts are often unsuccessful when made by the female herself, and even by an ignorant accomplice. A tailor's apprentice attempted to produce abortion in his mistress, by thrusting into her vagina the large scissors, used in his trade, and cutting with them. He wounded the vagina, but failed in his purpose.(*b*) Although the use of instruments generally indicates the intervention of another person, yet cases are known in which the woman has herself succeeded in introducing them. Thus, in a case in this country, a female brought on abortion by "probing herself with a piece of whalebone," and she declared that she had miscarried five times previously by the use of drugs.(*x*) More frequently, however, the abortion is accomplished through the culpable assistance of persons who make a trade of this nefarious practice. While, for the most part, the persons who are ready to degrade their humanity to this occupation are exceedingly ignorant and wholly unskilled in medical knowledge, it cannot be denied that occasionally medical men lend their skill to the accomplishment of the woman's purpose. Such conduct cannot be too strongly condemned, and is the more deserving of

(*w*) Traité d'Auscultation Obstetricale, p. 270.
(*a*) Scanzoni, Med. Times and Gaz., Oct. 1853.
(*b*) Casper's Gericht. Med. ii. 251.
(*x*) New York Journ. of Med., vol. vii. p. 199.

receiving the punishment awarded for the criminal offence in question than are the blundering and reckless attempts of those less skilled, and who may, in many instances, be scarcely aware of the probable results of the operation to the mother.(*y*) In

(*y*) "We blush, while we record the fact, that in this country, in our cities and towns, in this city, where literature, science, morality, and Christianity are supposed to have so much influence; where all the domestic and social virtues are reported as being in full and delightful exercise; even here individuals, male and female, exist, who are continually imbruing their hands and consciences in the blood of unborn infants; yea, even *medical* men are to be found, who, for some trifling pecuniary recompense, will poison the fountains of life, or forcibly induce labor, to the certain destruction of the fœtus, and not unfrequently of its parent.

"So low, gentlemen, is the moral sense of the community on this subject, so ignorant are the greater number of individuals, that even mothers, in many instances, shrink not from the commission of this crime, but will voluntarily destroy their own progeny, in violation of every natural sentiment, and in opposition to the laws of God and man. Perhaps there are few individuals, in extensive practice as obstetricians, who have not had frequent applications made to them by the fathers or mothers of unborn children (respectable and polite in their general appearance and manners), to destroy the fruit of illicit pleasure, under the vain hope of preserving their reputation by this unnatural and guilty sacrifice.

"Married women, also, from the fear of labor, from indisposition to have the care, the expense, or the trouble of children, or some other motive equally trifling and degrading, have solicited that the embryo should be destroyed by their medical attendant. And when such individuals are informed of the nature of the transaction, there is an expression of real or pretended surprise that any one should deem the act improper, much more guilty; yea, in spite even of the solemn warning of the physician, they will resort to the debased and murderous charlatan, who, for a piece of silver, will annihilate the life of the fœtus, and endanger even that of its ignorant or guilty mother.

"This low estimate of the importance of fœtal life is by no means restricted to the ignorant, or to the lower classes of society. Educated, refined, and fashionable women—yea, in many instances, women whose moral character is in other respects without reproach, mothers who are devoted, with an ardent and self-denying affection, to the children who already constitute their family—are perfectly indifferent respecting the fœtus in utero. They seem not to realize that the being within them is indeed *animate*—that it is, in verity, a *human being*, body and spirit; that it is of importance; that its value is inestimable, having reference to this world and the next. Hence, they in every way neglect *its* interests. They eat and drink; they walk and ride; they will practise no self-restraint, but will indulge every caprice, every passion, utterly regardless of the unseen and unloved embryo. They act with as much indifference as if the living, intelligent, immortal existence lodged within their organs were of no more value than the bread eaten, or the com-

the one case, the practice may be carried on for a considerable time with impunity, and hence a larger number of children be

mon excretions of the system. Even in cases where mothers have suffered from repeated abortions, where fœtus after fœtus has perished through their neglect or carelessness, and where even their own health is involved in the issue, even in such cases every obstetrician can bear testimony to the great difficulty of inducing our wayward patients to forego certain gratifications, to practise certain self-denials, and to adopt efficient means for the salvation of the child.

"This is not all. We can bear testimony that in some instances the woman who has been well educated, who occupies high stations in society, whose influence over others is great, and whose character has not been impugned, will deliberately resort to any and every measure which may effectually destroy her unborn offspring. Ashamed, or afraid, to apply to the charlatan, who sustains his existence by the price of blood, dreading, it may be, publicity, she recklessly and boldly adopts measures, however severe and dangerous, for the accomplishment of her unnatural, her guilty purpose. She will make extra-muscular efforts by long, fatiguing walks, by dancing, running, jumping, kept up as long as possible; she will swallow the most nauseous, irritating, and poisonous drugs; and, in some instances, will actually arm herself with the surgeon's instrument, and operate upon her own body, that she may be delivered of an embryo, for which she has no desire, and whose birth and appearance she dreads.

"These facts are horrible, but they are too frequent and too true. Often, very often, must all the eloquence and all the authority of the practitioner be employed; often he must, as it were, grasp the conscience of his weak and erring patient, and let her know, in language not to be misunderstood, that she is responsible to her Creator for the life of the being within her."—*On Criminal Abortion;* a Lecture introductory to the Course on Obstetrics, etc., in the University of Pennsylvania, by Hugh L. Hodge, M.D. Philadelphia, 1854.

In an article upon this subject (Annales d'Hygiène, 1856, v. 121), M. Tardieu, after referring to the crime as one allowed to go unpunished, and as a source of wealth to more than one midwife in New York, says (p. 125): "In common with the magistrates and the mortality inspectors of Paris and its environs, I am convinced that criminal abortion constitutes a trade as free as it is immoral. So well is this fact known, that houses are openly shown where women may be sure of meeting with the wicked accomplices they require, and which are notorious even beyond the frontiers." Statistical reports, analyzed by Dr. H. R. Storer (N. Amer. Med. and Surg. Journ., 1859), render it probable that the prevalence of this crime in the United States and in Europe is greater than those who have not examined the subject could conceive to be possible. Dr. Walter Channing, of Massachusetts, refers to the difficulty of obtaining a conviction for abortion, and adds: "I believe there has never been one in this State, this moral State by eminence, and perhaps in none is this crime more rife." (Boston Med. and Surg. Journ., April, 1859, p. 135.)

secretly sacrificed; in the other, the career is usually short or interrupted, for its murderous consequences become too soon apparent.

§ 93. It is not necessary to describe the manner in which the operation is performed. The deplorable results of the clumsy manœuvres usually practised are sometimes, though rarely, brought to light. An inquest was held at Nottingham in a case of abortion which had been produced by the introduction of a wooden skewer into the uterus. The child's head had been perforated by this instrument; it was four and a half months old. A verdict was rendered, in accordance with the surgical evidence, that the woman had died of peritonitis, caused—by the rupture of an abscess in the ovary!(*z*) A female, a single woman, went to the house of the prisoner, and, having informed her of her pregnancy, underwent an operation, as described by witness, of having a pin thrust up into the womb. This was repeated for several days, and it ended in the delivery of a male child of about six months' development. The child was born alive, but died about five hours afterwards.(*a*) Dr. Channing relates the case of a woman who, believing herself to be pregnant, attempted to produce abortion by introducing into the womb a piece of soft wire bent upon itself for an inch or more at the further end. She succeeded in thrusting the wire into the uterus, but was unable to withdraw it, and, after suffering severe pain, she called in medical aid, but the wire could not be removed. Her attending physician then cut it off as high up as possible, and six years afterwards the wire was still there. In this case the female was not pregnant.(a^1)

§ 94. Zuchmeister(a^2) says that he was called upon to remove a foreign body from the vagina, which had pierced one lip of the os uteri. Upon examination it proved to be a twig of the prunus spinosa, which is said by the reporter to be much used in Essen by those practising this detestable trade.

(*z*) Lond. Med. Gazette, xlv.

(*a*) Am. Journal, April, 1851, p. 526, from The Queen *v.* West, Carrington and Kirwan's Nisi Prius Reports, vol. ii. p. 784.

(a^1) Boston Med. and Surg. Journal, April, 1859, p. 137.

(a^2) Allg. Wien. Med. Zeit., 1864, p. 81.

§ 94*a*. The operation required is one of an exceedingly delicate and difficult nature, and even those who are conversant with the anatomical arrangement of the parts interested require to be careful in their manipulations. The operation of inducing premature labor in this way has been sometimes attended with accidents. Thus, Dr. J. B. S. Jackson reports an instance in which the internal iliac artery was opened by an instrument introduced for the purpose of expediting labor.(*b*) A similar case is recorded, in which the left common iliac was punctured. In this case, which was brought to trial, the jury returned a verdict that the woman had died of a spontaneous rupture of the artery.(*c*) In France an attempt was made recently to produce abortion by the injection of a corrosive and irritating substance into the vagina.

§ 95. It is evident that in all these cases of local violence, should death result, a careful anatomical inspection would reveal the crime. In case, however, the woman survive the operation, a medical examination would probably be superfluous.

We do not recollect to have met with any case of criminal abortion more horrible than that reported in one of the English medical journals.(*d*)

A man named Asher, known as an "herb doctor," undertook, for the sum of two sovereigns, to procure abortion upon the person of a woman named Elizabeth Fletcher, who, in the absence of her husband, had become pregnant. The operation was performed upon the woman at his own house, and from that moment she began to suffer pain, which increased, and she became seriously ill. Asher being called upon to see her, "introduced *his hand and arm into the vagina*, and kept them there from five to ten minutes, during the whole of which time the woman was in frightful agony." From this time the pain increased greatly in severity, and vomiting commenced. Her death ensued in less than a week from the operation. An examination of the body was instituted. There were marks of contusions extending from about two inches below the umbili-

(*b*) Dublin Med. Press, Aug. 1848. (*c*) Ibid.
(*d*) Med. Times and Gazette, March, 1855.

cus, on either side, to the symphysis pubis. The muscles of the abdomen, at this part, were infiltrated with pus, and coagulated blood was found between them. Recent adhesions united the omentum to the surface of the intestines, and blood was extravasated in the vicinity of the uterus and bladder. The bladder was almost black, and in a state of gangrene. In its posterior wall was a large lacerated opening, and an aperture of considerable size in the corresponding part of the anterior wall of the neck of the uterus; two-thirds of the neck of the uterus were detached from the body of the organ. Through these openings the fœtus had escaped *from the uterus into the bladder*, in which latter viscus it was found, together with some coagulated blood. This criminal, who is described as a "gray-headed old man, upwards of sixty years old," and who appears to have had much experience in performing those iniquitous operations, was sentenced to transportation for fourteen years only.

§ 96. (1) *Premature labor* is frequently induced in *legitimate medical practice*, for the purpose of avoiding the risks which in some cases attend parturition at term. The pelvis is sometimes so much deformed, that a mature child cannot possibly be born alive. The choice, in such cases, lies between the Cæsarean operation and an artificial premature birth. The proportion of children born at seven months that live, is, of course, smaller than if they were carried to the end of gestation, and could be delivered; but as, in the cases of deformity alluded to, the child's life must inevitably be sacrificed by birth through the natural passages, it becomes a vital question how its life may be preserved with the least risk to the mother. The statistics of the results of the Cæsarean operation give no cheering view of its value; the danger to the mother's life is infinitely greater than in the induction of artificial labor, which, in fact, in competent hands is a trifling operation. The average number of children saved by this means is rather more than one-half of the cases operated upon. The practice which, when first proposed, awakened some doubts as to its morality, has now received the sanction of the highest medical authorities, and is universally regarded as justifiable and beneficent. Although deformity of the pelvis is usually the motive for the operation, it may be properly employed in other cases, as, for

example, in women whose children habitually die before the term of gestation is reached, or who are suffering from diseases the danger of which is much heightened by the continuance of pregnancy. Yet the propriety of its employment in the latter case must be admitted with some reserve; the sympathetic phenomena of pregnancy are often far more alarming in appearance than in reality, and will rarely justify any interference with the natural progress of gestation. In all cases, the physician should consult with one or more of his colleagues before inducing premature labor; in this manner, his humane intentions will not expose him, in case of failure, to reproach, suspicion, or prosecution.

§ 97. (2) *Blows upon the abdomen* are often designedly given with the view of causing a woman to miscarry. It is impossible to define the degree or mode of violence required to effect this purpose. Where uterine hemorrhage occurs shortly after ill-usage of this nature, it is reasonable to attribute it, and the abortion which follows, to the violence used. Great circumspection is, however, necessary in giving a positive opinion when the hemorrhage preceding the miscarriage is not the immediate consequence of the injuries received, since a woman may happen to abort from other causes, or she may be near her confinement. In such a case, it may be necessary to determine whether labor has been spontaneous, or been provoked by the ill treatment. Ordinary labor does not commence with free hemorrhage (except in the case of placenta prævia), while, on the contrary, that which is brought on by blows upon the abdomen does so because the placenta becomes, by this violence, partly or wholly detached from the uterus. If the violence has, however, been inflicted upon other parts than the abdomen and loins, this criterion cannot be safely relied upon, and the dependence of the premature labor upon the injury must be established by other means.

§ 98. 5th. *Signs of abortion.*—The *signs of abortion* having taken place are obtained—(1) From an *examination of the object expelled.* This is necessary, in order to determine *its human character* and *its probable age.* Other bodies are expelled from the womb which bear a greater or less resemblance to the human embryo, but are not always the products of conception.

Most frequently, however, they are the products of conception, but in a diseased condition.

§ 99. The substances called *moles*, which are not unfrequently met with, fall under this denomination. The fleshy mole (also called "false germ") is composed of layers of fibrous matter inclosing a central cavity, in which sometimes fragments of the embryo can be recognized, but in others it appears to have been dissolved in the amniotic liquor. This body is supposed to be a hypertrophy of the placental surface of the chorion. The hydatid mole, or *môle vesiculaire*, is certainly a morbid alteration of the placental surface of the chorion. Velpeau and Mad. Boivin (*e*) have given so clear and accurate a description of the real character of this pathological product, that there remains but little of the mystery which formerly enveloped it. It consists of a dilatation of the cellular spongioles of the chorion. These increase, until they form a mass inclosing the ovum more or less completely. The remains of the fœtus are sometimes found; (*f*) at others, again, the disease would seem to have originated at so early a period, that the embryo has become dissolved in the amniotic fluid. In this case, a trace of umbilical cord is sometimes found. These hydatids may remain in the uterus a much longer time than the usual duration of pregnancy; and hence, as they are the result of conception, an opinion as to their probable age should be given with great caution, lest unjust aspersions should be thrown upon the character of the woman. The principal obstetrical authorities relate instances of the expulsion of hydatids from the uterus at ten, eleven, and fourteen months after conception, and some agree in admitting that they may be retained many years. Dr. Montgomery says, that he has not met with any instance of such long retention. (*g*)

§ 100. In cases of difficult menstruation, there are sometimes expelled substances which by some persons might be mistaken

(*e*) Nouvelles Recherches sur l'Origine, la Nature, etc., de la môle vesiculaire.

(*f*) Dr. J. B. S. Jackson exhibited to the Society for Medical Improvement in Boston, a specimen, showing uterine hydatids connected with the membranes of a four months' fœtus. Am. Journ. Med. Sci., April, 1850, p. 359.

(*g*) Pregnancy, etc., 2d ed., p. 267.

for an early ovum. These are in some cases, false membranes, occasionally discharged entire,(*h*) preserving the shape of the uterine cavity; in others, again, they are membranous concretions, originating from coagula of blood. The first variety is distinguished from the ovum by the absence of the flocculi of the chorion, to which the outer surface of the menstrual membrane, however rough it may be, bears no resemblance.(*i*) In the other, the central cavity is wanting, and no trace of umbilical cord or placental surface can be found; besides this, it differs from the ovum in shape, being longer, thick in the middle, and pointed at either end. Of these productions, Dr. Denman says: "As the first cases in which this membrane was discharged were those of married women, a doubt arose in my mind whether it was not really a consequence of early conception, but I have lately had the most undoubted proofs that it is sometimes discharged by unmarried women, and may be found previous to and without connubial communication; and that the uterus has occasionally, or constantly, in some women, the property of forming it at or in the interval between the periods of the menstrual discharges. It seems particularly necessary to establish this fact, as the appearance of this membrane has more than once given rise to erroneous opinions and unjust aspersions."(*j*) In examining doubtful masses expelled from the womb, they should be carefully cleansed and macerated in water, to dissolve the coagula.

§ 101. In conclusion, it may be mentioned that there can be no danger of mistaking for ova the *polypi* which are sometimes discharged from the uterus, since these are easily recognized by the remains of the pedicle, as well as by their structure.

§ 102. The brief description given above of the various substances which may be discharged from the uterus, will suffice, we hope, to show that those which are called *moles* and hydatids are diseases of the appendages of the embryo, and that, even if no trace of the latter remain, yet the existence of

(*h*) Dubois, of Neufchâtel, gives the case of a girl who, at every menstrual period, expelled a hollow membranous body corresponding exactly with the shape of the uterus. Gaz. Méd., 1847, p. 729.

(*i*) Churchill, Dis. of Females, p. 103.

(*j*) Introduct. to Midwifery, p. 161.

these peculiar degenerations places the fact of impregnation beyond question; while, on the other hand, the products of a disordered menstrual function are so different in character as to be recognized as such without difficulty.

§ 103. The probable age of the ovum, or of the fœtus, is ascertained from a consideration of the degree of its development. It is impossible to declare with positive accuracy the dimensions, weight, and degree of development of the fœtus at any given period of its intra-uterine life. The date of conception can never be known with certainty, and even if it could, and the age of the fœtus be ascertained, yet the weight and length, as well as the development, depend upon individual peculiarities. The same variety that is found in the bodily proportions of adults must prevail in the fœtus. Hence, the statements which follow must be looked upon as averages only.

§ 104. At the earliest period at which the human embryo can be recognized, it is of a somewhat crescentic shape, with the cephalic extremity large and rounded; it is a semi-transparent viscid mass, and from the lower portion of its concave side the umbilical cord takes its origin. The whole ovum presents a loose, shaggy appearance, arising from the tufts of the chorion. A few weeks later, this is confined to only a portion of the surface of the ovum, from which the placenta becomes afterwards developed.

In the course of the *fourth and fifth week*, the rudiments of the several parts of the fœtus become distinct. The mouth is the first feature which is observed, and is very large, and of a triangular shape; the eyes are like two black specks, and the liver occupies the whole of the abdomen. A moving point can be seen where the heart is afterwards developed, but the blood is not yet of a red color.

By the *sixth week* the forearm and leg are distinct, and the former is detached from the side, to which it was bound. The rudiments of fingers and toes can be discerned. At the *eighth week* the head forms more than one-third of the body, the features are more distinct, but the sex is not yet manifest. Red blood is found in the vessels of the cord.

At *three months* the fœtus has attained the length of two to

two and a half inches (Devergie), and the size of the whole ovum is about that of a goose's egg. The fingers are separated, the toes are connected together by a soft substance, the soles of the feet are turned inwards, and the genital organs are quite distinct, having indeed a size and prominence disproportioned to their subsequent development.

At *four months*, the length is from five to six inches (Devergie, Velpeau), and the weight, as given by the best authorities, is very various, ranging from two and a half to eight ounces. At this time the pupillary membrane is more distinct than before, the skin is rosy but very delicate, and covered with a fine down, while the hair of the head is short, and of a silvery-white appearance.

At *five months*, the fœtus is from six to seven inches long, and weighs from five to seven ounces (Devergie). The head forms one-fourth of the body. The large intestines contain meconium in their upper portion. Quickening takes place usually at the beginning of the fifth month. In case of abortion at this period, the fœtus usually escapes first through the ruptured membranes, these, with the placenta, following it.

At *six months*, the head is no longer so disproportioned to the size of the body, and the umbilical cord arises a little above the pubis. The length is from nine to ten inches, and the weight one pound (Devergie). Fat is found in small quantity under the skin; the latter is of a purplish color, especially in the palms of the hands and soles of the feet, as well as in the lips and ears. The scrotum, however, is of a reddish color; the testicles are still in the abdomen. In females, the external labia project, but do not conceal the clitoris, which is large and prominent. The pupillary membrane is distinct and firm. The nails look like folds of skin. The hair is still scanty and short, and of a silvery-white color.

At *seven months*, the fœtus is found to have increased in all its proportions. It measures in length from twelve to fourteen inches, and weighs from two to three pounds. The bones of the head are still yielding on pressure; the frontal bone consists still of two parts; the ears lie close to the head; the arms and legs are bent in the position which they had in the uterus, if the child be born alive. At the *eighth* month, the length is

from sixteen to eighteen inches, and the weight three or four pounds. The skin, in color and thickness, is more like that of a child at term; it is covered with a fine short hair, and the hair of the head is of a darker color. Sometimes one of the testicles (generally the left) has descended into the scrotum; usually, however, they have not passed the abdominal ring. The pupillary membrane begins to disappear towards the close of the month. During the *ninth* month the fœtus gradually increases its length, until it attains from eighteen to twenty-two inches, and in weight on an average about seven pounds. The characteristic marks of maturity are considered to be the following:—

§ 105. The average length of a healthy, mature child is about eighteen inches, and its weight from six to seven pounds. Its skin is of a reddish-white color; the hair is pretty thick and strong; the nails of the fingers perfect, and the ears cartilaginous. The limbs are firm and rounded, and the testicles of the males usually are found in the scrotum. According to Moreau, the navel string is inserted a few lines below the centre of the body—a statement which is confirmed by the observations of Drs. Taylor,(*k*) Ollivier, and Elsässer, although opposed to the opinion formerly held, that its point of attachment at the end of gestation was exactly the centre of the body. It is, moreover, firm and elastic. The child breathes and cries immediately after birth unless the third stage of labor has been protracted; is able to take the breast and swallow, and within a few hours passes its urine and meconium. The meconium, however, is often not passed for two or three days; and in some cases is voided unobserved during birth. The presence of the *vernix caseosa*, a sebaceous secretion upon the skin, is found, according to Elsässer, upon about one-half of newly-born children.

§ 106. The several signs of *immaturity* may be thus stated in

(*k*) Med. Jur., p. 285, Am. ed. Dict. des. Sci. Med., Art. *Œuf*. Henke's Zeitschrift, Bd. 42, p. 256. Dr. Elsässer also states, that in the well-proportioned adult, the middle of the body is not at the navel, but at the rising point of the *mons veneris;* a fact, which, he says, is generally received by artists and confirmed by a measurement of the best antiques.—S. Tabelle für bildende Künstler von Joseph Mattersberger (nach Antiken), 1805.

general terms. The body is small, lean, and flaccid; the skin tender, wrinkled, red, and upon the palms and soles, purple; and the lips, ears, and genitals bleed very easily. The head is out of all proportion to the body, as is also the skull to the face; the bones of the skull are widely separated by membranous sutures, and very movable; the hair of the head is scanty, short, and silvery; the eyelids and lashes are downy. The face has an old and painful look; the pupillary membrane is present, and the ears are thin and membranous. The navel string is attached near the pubes; the scrotum is very red, and not much wrinkled; the testicles are still in the abdomen; the lips of the vulva stand apart from each other, and the disproportionate clitoris protrudes between them.(*l*) The immature child, moreover, breathes with difficulty; its voice is weak and whimpering; it sleeps continually, cannot suck, and shows no desire for food.

§ 107. (2) The signs of abortion, as obtained by an *examination of the female*, are not very certain in their character. It is seldom, indeed, that an examination of the living female is had, and especially at a period early enough to afford any valuable indications. When abortion occurs in the early months, it leaves but slight and evanescent traces behind it. A relaxed condition of the parts, which at the same time are covered with blood proceeding from the womb, resembles so closely the condition present during the catamenial flow that, practically, they could hardly be distinguished. The open state of the mouth of the womb may, in some cases, throw light upon the question. All these signs are, however, more distinct in the latter half of pregnancy, and, as the term of gestation approaches, closely resemble the signs of "delivery." (See § 23.)

We also refer the reader for a consideration of the value of the *corpora lutea*, as indicative of pregnancy, to the chapter on the Signs of Delivery. We would merely repeat here, that although there is, in our opinion, sufficient evidence of a marked difference between the *corpora lutea* of pregnancy and those of menstruation, it requires more general assent and

(*l*) Bock, loc. cit., p. 241.

more complete substantiation to allow positive inferences from their discovery to be put forward in criminal, or other important cases, without reserve.

For the latest views upon the corpus luteum *vide* Waldeyer's article upon the Ovary and Parovarium, in A Manual of Human and Comparative Histology, by Stricker. N. Syd. Soc. Trans., Vol. II., p. 203.

CHAPTER VI.

INFANTICIDE.

§ 108. 1st. *Characteristics of stillborn and living children.*— In the following considerations upon this subject, we shall restrict our remarks to the medical testimony required in the determination of questions arising out of the doubtful causes of death in *new-born* children. By this phrase we propose to designate those cases in which doubts concerning live birth may fairly be entertained. Those which do not require the solution of this question as preliminary to a judgment upon the fact or the manner of criminal interference, cannot, with strict propriety, be classified under the head of Infanticide. The degree of criminality of the offence is determined by the period at which it was committed, whether before or after birth; but manifestly this point is, at a certain period after birth, no longer subject to doubt. The mode of death at this time, whether criminal or otherwise, will be determined by the same general rules that are applicable in adult life. Hence the first purpose of medical investigation in cases of alleged infanticide, is to ascertain whether the child was born alive.

The evidences of the child having died before birth have been sought in the cessation of the intra-uterine movements and the sounds of the fœtal heart, and in certain changes in the mother, such as a tendency to fainting, nausea and vomiting, loss of appetite and foul breath, a dull, pale, and dejected look, a sense of pressure upon the bladder and rectum, or of the falling of the contents of the womb from side to side, or,

finally, the discharge of meconium or blood or the protrusion of the umbilical cord. But however probable these phenomena may render the death of the child, they do not demonstrate it.

More certain signs are furnished by the condition of a child born dead, provided its birth have taken place three days or more previous to its expulsion from the womb. These will be described in another place.(*l*[1])

§ 109. In order that the reader may have a clear view of the evidence required to establish the fact that a child was born alive, it will be necessary to prefix to it a comparative sketch of the stillborn child and that which is born living. The visceral and other changes which indicate that a child has survived its birth, derive all their importance, as evidence, from a contrast with the condition and peculiarities of the same organs in the fœtus: and the degree to which the change has been accomplished, corresponds in general with the energy and extent of the new functions. Hence, before we can safely determine that a new-born child has been criminally destroyed, we must be prepared to show, as a necessary preliminary, and beyond the shadow of a doubt, that the essential fœtal characteristics no longer exist.

§ 110. *A child which is born dead*, having perished immediately before its birth, will be usually found, in medico-legal cases, owing to the hurry of concealment, to be still covered with the sebaceous secretion called *vernix caseosa*. Its hair is closely agglutinated; its ears lie closely to the head; the eyes are closed, and the eyelids when raised do not remain open. The mouth also is closed, and a drop of watery blood is often seen trickling from the nostril. The thorax, being unexpanded by respiration, appears flat and contracted, and the remnant of the umbilical cord has a fresher look than in a child which has lived for a few hours. The trachea is flattened, and often contains a viscid mucous secretion. *The lungs* lie in the posterior part of the thorax, and the rest of this cavity is often filled with a yellowish fluid of a slightly glutinous consistence. They are of a brownish-red color, more or less spotted in some cases, have a granular structure, and do not crepitate upon

(*l*[1]) See title "Abortion," in index.

incision. Their length is greater than their breadth, and their edges are rounded. Their absolute weight is less than after respiration has occurred, since upon their expansion by this process, an active circulation of blood takes place through them; but their specific gravity is greater, their vesicular structure being undistended with air.

§ 111. A child which has been *born alive* presents the following characteristics; the period of survivance, the mode of death, and the time after it, at which the examination is made, have of course a considerable influence upon these. As a general rule, however, if the body be fresh, the remains of the *vernix caseosa* will be found under the armpits, behind the ears, etc., the hair will be dry and clean, the ears not so closely applied to the head as in the stillborn child, and the eyes remain half open, in spite of all efforts to close them. The swelling upon the back of the head which is common in new-born children (*caput succedaneum*), in whom the head has been the presenting part, is far more marked in the child which is born alive than in the stillborn; provided death has occurred before the expulsive pains of labor have begun. In the one case, it also contains a glutinous bloody serum, while in the other, the small quantity of liquid effused is colorless. The thorax is higher and more arched than in the fœtus, and the diaphragm is depressed in a corresponding degree by the expansion of the lungs. As a general rule, according to Casper, the highest level of the diaphragm will be found between the fourth and fifth ribs in stillborn infants, and between the sixth and seventh in the living.

§ 112. The *umbilical cord* affords more valuable proof of extra-uterine life, as well as of the period of its duration, than any other of the external marks. It is generally of a bluish pearly-white color, of the thickness of a finger, and within twelve to twenty-four hours after birth, loses its polish and becomes dry and flaccid. The process of desiccation begins at the severed end, and in the course of twenty-four hours reaches to within half an inch of the navel; this portion of it still remaining pulpy and of an amber color. About this time the skin of the abdomen, around the attachments of the cord, becomes red and swollen, and is pushed up around it in the

shape of an inverted cone. During the second and third days the cord dries gradually away, becomes twisted and flattened like a ribbon, while the preparatory stage of separation is seen in the suppurative process which attacks the still moist portion by which it remains attached to the navel. On the fourth day, the cord is found to have acquired a yellowish-brown or black color, and in those parts of it not traversed by the umbilical vessels has the transparency and appearance of glue. The separation takes place more frequently on this than on the third day, but the time of its falling off is subject to great variation. According to the observations of Dr. Elsässer,(*m*) out of one hundred and thirty cases, it occurred—

On the 4th day in 10 cases, on the 7th day in 16 cases, on the 10th day in 1 case.
" 5th " 40 " " 8th " 5 "
" 6th " 55 " " 9th " 3 "

Cicatrization of the navel is generally complete by the fourteenth day.

§ 113. The process of desiccation above described is not invariable. Occasionally where the navel string is thick and pulpy, instead of withering and drying away, it will putrefy, even in the healthiest children. Elsässer has often made this observation in his hospital at Stuttgart, and the fact is fully confirmed by the observations of Sömmering and Osiander.(*n*) Moreover, the process of desiccation is not confined to the cord of living children alone. In two stillborn children, Elsässer found the cord still remaining on the fifteenth and twenty-eighth day respectively after birth. It had undergone complete desiccation into a horny substance, while the bodies of the children were at the same time considerably advanced in putrefaction. Pieces of umbilical cord cut off and exposed to the open air, at 40° to 60° Fahrenheit, underwent the same withering and desiccating process as in the living child, and without the least foul smell. These observations may appear to invalidate the statement of Billard, which has been generally accepted as correct, viz., that the desiccation of the cord is an act of vitality, and consequently cannot and does not occur in the stillborn child. That they do not, however, materially affect

(*m*) Henke's Zeitschrift, 1852, 4 Heft. p. 262.
(*n*) Uber die Nabelbrüche. Lehrbuch für Habammen.

its truth is evident, when we reflect that the process in the living child commences immediately after birth, and is completed generally within three or four days, whereas, in these observations, actual desiccation did not commence until much later, in one case on the ninth day, and in the other as late as the twentieth day. Furthermore, in neither case was there any indication of the cord becoming detached, a process which is alone of no trifling significance, both as evidence of life and of its duration. Hence, the withering and desiccation of the cord give a fair presumption that the child has lived and the degree to which the process has advanced, a valuable indication of the length of time it has survived its birth.

§ 114. Several other subordinate signs of live birth may be alluded to before we consider those derived from the condition of the lungs. One of these is *suggillation*, or a discoloration resembling a bruise, and which has been held to be a proof that respiration occurred. But it is now admitted to furnish no reliable evidence of life after birth. The same remark is applicable to the difference of color, which, it is said, theoretically, must be presented by *the blood* in the opposite cavities of the heart. The absolute or relative weight of the *liver* is also a fallible test. For although it is true that this organ diminishes in size in proportion as the lungs assume their function, yet it is impossible by its means to determine in any particular case in what degree, if at all, the lungs have expanded, because the degree of contraction of the liver, not being referable to any fixed standard, can neither be measured nor estimated. The discharge of meconium, or of urine, as tests of breathing are also unreliable.

§ 115. Of late years great importance has been attached to the condition of the centre of ossification in the lower end of the thigh-bone, which, it is claimed by Casper and other authorities, presents a very reliable criterion of the age of the newborn child.

The value of this sign was first pointed out by Beclard, Ollivier, and Mildner. Casper gives a table of one hundred and twenty-five cases in which he investigated the condition of the osseous nucleus, and as the result of these observations says:—

"*a.* When there is yet no visible trace of the centre of ossi-

fication in the inferior femoral epiphysis, then the fœtus can be no more than from thirty-six to thirty-seven weeks old.

"*b.* The commencement of this osseous nucleus, which is at first about the size of a hempseed or the head of an ordinary fly (half a line), indicates a fœtal age of from thirty-seven to thirty-eight weeks, supposing the child to have been stillborn; in the opposite case the child may have been born alive before this time, without any osseous nucleus, which then becomes developed during its extra-uterine life. In rare instances of unusually retarded development, a fœtus of forty weeks may exhibit only a trifling commencement of this nucleus.

"*c.* When this osseous nucleus possesses a diameter of from three-quarters to three lines, it indicates that the fœtus must have attained a uterine age of forty weeks, always supposing of course that the child has been stillborn. In one instance of unusually retarded development, with defective ossification of the skull, of a girl born perfectly mature, we found no osseous nucleus.

"*d.* We may conclude that the child has lived after its birth, when the osseous nucleus measures *more* than three lines. But, on the other hand, an osseous nucleus of less than three lines does not prove that the child has not lived."(*o*) This symptom is only regarded as confirmatory by Casper, and as possessing especial value from the fact of the resistance it offers to putrefactive change. Voltolini (*o*[1]) reports an instance of exception to this rule where the nucleus measured four and a half lines, but in which the child died immediately after birth.

§ 116. The *lungs* are the source from which the most reliable proof of live-birth is derived. In the child which has perfectly respired, the lungs occupy a larger space in the thorax than in the stillborn fœtus. They fill up, in general, its cavity completely, and partly cover and conceal the pericardium. Their color is of a pale red, shading into blue on the posterior surface, and becoming brighter upon exposure to the air, or else irregular light-red spots appear upon a bluish-red ground.

(*o*) Casper's Forensic Medicine. New Syd. Soc. Trans., vol. iii. p. 27.
(*o*[1]) Casper, vol. xvi. Part I.

This gives them a marbled appearance, a peculiarity which cannot be given to fœtal lungs by inflation. Their edges are sharp, here and there curved inwards or projecting in tongue-like processes. They feel tough but not solid when handled, and retain slightly the impression of the finger. They crepitate also when pressed or cut, and upon incision yield a small quantity of frothy blood. They are heavier than the fœtal lungs, but specifically lighter than water, floating upon it both with the heart and thymus gland attached, and also when cut to pieces. When pressed between the fingers under water, air bubbles rise from them to the surface. The thorax is wider and more arched than in the fœtus, and the diaphragm is lower than before respiration, its convexity not reaching above the seventh or eighth rib. As the conditions thus described belong to lungs which have fully respired, a less perfect degree of them may be expected to be found when the respiration has been incomplete, and cases may even occur in which very small portions only of the pulmonary tissue have been penetrated by air, and consequently are capable of floating when subjected to the hydrostatic test.

The condition of the *larynx* before and after breathing is not the same. In the former case it is narrower, is occupied by mucus, and is closely in apposition with the epiglottis; but in the latter this covering no longer closes the opening to the larynx. None of these conditions, it will be observed, affect the question *when* the child breathed? They are equally consistent with breathing before and after birth.

§ 117. Certain changes take place in the *fœtal channels* for the circulation of the blood, upon the occurrence of respiration. As, however, these changes are gradual in their nature, they can hardly with propriety be enumerated among the signs of live-birth. They are only considered in this place from the fact that they *commence* at birth, although not perfected until a later period. From the cases reported by Elsässer,(*o*²) it will be seen that the obliteration of the fœtal channels occurs in a very indeterminate manner. In forty-eight out of fifty-two mature stillborn children they were all open except in four, in

(*o*²) Henke's Zeitsch., 1841 and 1852.

which the *foramen ovale* was closed. In ninety-two who died in the first month, they remained open in two-thirds. Later researches on a still more extensive scale by the same indefatigable author, prove, as the result of the examination of three hundred and seventy cases, the little reliance which can be placed on so variable a test. In illustration of this fact, we may remark that in one stillborn child the *ductus venosus* was found closed, and in a child which lived only a quarter of an hour, the *foramen ovale and ductus arteriosus were both closed.* On the other hand, in a child thirty-nine days old, he found *all* the fœtal channels remaining open. Dr. Norman Chevers(*p*) substantiates this statement by the facts which he has collected respecting the frequent contraction and obliteration of the foramen ovale and the ductus arteriosus before birth. It is evident that if but one authentic case exists in which any of the fœtal channels have been found closed at birth, it is enough to throw doubt upon any case in which its closure is assigned as a proof that the child must have survived its birth. Moreover, the continued patency of these channels is of still less importance in a medico-legal sense than their closure, since the foramen ovale and ductus arteriosus are found open in certain cases in adult life. We have ourselves elsewhere brought abundant proof of this fact.(*q*)

§ 118. Professor Bernt,(*r*) of Vienna, has endeavored to determine, by means of the progressive closure of the foramen ovale and ductus arteriosus, the period during which the newborn child has survived, and his views have heretofore met with considerable attention, and been adduced as authority. He says: "1. If the child has lived only a *few seconds*, the aortal end of the duct appears contracted, and the vessel, instead of being cylindrical throughout, acquires the form of a truncated cone. 2. If the child has lived for *several hours* or a *whole day*, the duct becomes again cylindrical, although shortened and contracted in diameter. Its size is about equal to

(*p*) Med. Gaz. xxxv. and xxxvi.

(*q*) On Cyanosis. Am. Journ. Med. Sci., July, 1844.

(*r*) Das verfahren bei der ger-med. Ausmittelung zweifelhafter Todesarten der Neugebornen, von Joseph Bernt. Wien. 1826. *Vide* Taylor, Med. Jur., p. 319.

that of a goose-quill; it is, therefore, much smaller than its root, and about as large as either of the two branches of the pulmonary artery, which have in the mean time become increased in size. 3. If the child has lived for *several days* or a *whole week*, the duct contracts to the diameter of a few lines, about equal to a crow-quill, while the two branches of the pulmonary artery are equal in size to a goose-quill. 4. The duct is met with, perfectly closed, and quite impervious at a much later period, *i. e.*, after the lapse of a very uncertain number of weeks or even months." That these phenomena are far from being constant is attested by the experience of other writers(s) as well as by my own. I have never succeeded in finding the peculiar condition of the arterial duct, under the circumstances described by Professor Bernt. As has been before stated, the great irregularity in the process of obliteration, renders any dependence upon signs, which are at least neither constant nor well marked, highly fallacious. In fact, the alteration in the form and calibre of the fœtal channels is not noticeable immediately after birth; the closure of the foramen ovale, and the obliteration of the several canals, is gradual; they are not closed in any determinate order, although as a general rule, the foramen ovale is the last to be obliterated. These signs are, therefore, too inexact to be depended upon as proof of respiration having taken place, and have at most, only a secondary importance in the question as to the period of survivance.

§ 119. We have now to consider the characteristic marks by which a child which has respired *imperfectly* may be known from one that has not breathed at all, and also the pathological and extraneous causes of imperfect respiration.

The external aspect of a child which has breathed imperfectly, is not strikingly different from that of one which has fully respired. During its life, such a child will exhibit signs of feebleness, its cry will be weak and whimpering, its color pale, and its movements languid. If the imperfect expansion of the lungs be due to compression of the head or neck, owing to a tedious labor, or from some obstacle to de-

(s) *Vide* Elsässer. Also Taylor, loc. cit.

livery, the surface will be found of a livid hue, especially the face, and the child will gasp for air. In the lungs, however, will be found the principal indication of incomplete respiration. They will not reach as far forward as the pericardium; the brownish-red color of the fœtal lungs will be replaced, in part only, by the lighter and clearer red due to the presence of respired air, and these aerated portions will be found chiefly in the upper lobe of the right lung, owing to the size of the bronchial tube which opens into it being larger than that on the left side. These portions will float in water, while other parts of the pulmonary substance will sink, and the degree of buoyancy of the whole lung will depend upon the amount of air contained in it. As a general rule, it may be stated that a very small quantity of respired air is sufficient to cause the whole lung to float.

§ 120. The principal pathological cause of imperfect respiration is the condition called by Jörg, who first correctly described it, *atelectasis*. This word means *defective expansion*, and is appropriate, since a portion of the lung remains in the fœtal condition. We borrow the following accurate sketch from the valuable work of Dr. J. F. Meigs, on the Diseases of Children, p. 115: "In congenital atelectasis, the parts of the lung most frequently affected are the posterior portion and lower edge of the inferior lobes, the middle lobe of the right lung, and the languette and lower edge of the upper lobes. In some instances, as in one examined by myself, the greater portion of the lower lobes of both lungs, while in others still larger portions of these organs, have been found to present this condition. The imperfectly expanded portions of the lung are of a dark red or purplish color, and are diminished in size, so as to be depressed below the level of the healthy parts. They are solid to the touch, and yet they have not lost their cohesive properties, as they are neither friable, easily torn, nor readily penetrable by the finger, and no air bubbles are seen in the fluid squeezed out by pressure: they sink when thrown into water. They, in fact, resemble exactly the fœtal lung. The most convincing proof of the real nature of this condition, is obtained by the inflation of the lung. When this is done, the depressed, hard, and dark-colored portions, unless the subject

from whom the specimen has been taken may have lived long enough to have allowed the different tissues of the lung to become adherent, rise to their natural level, become elastic, soft, and crepitating, and change, under the influence of the entering air, from a dark and livid tint, to the rosy or pink color of healthy pulmonary tissue."

§ 121. The distinction between this condition and that of hepatization of the lung from inflammation must at once be evident to the physician. The only similarity is found in the increased density of the inflamed lung, in consequence of which it sinks in water. But we need hardly remind the reader that the occurrence of pre-natal or congenital pneumonia is very questionable, and that its immediate development after birth must be excessively rare. Should it, however, exist, it will not be difficult to distinguish it from atelectasis, except perhaps in those cases where a portion of the lung still remaining in the fœtal condition is attacked with inflammation. Such a case, however, would have no importance in a medico-legal point of view, since the phenomena observed on trial of the hydrostatic test would not be affected by it. Pneumonia attacks indifferently all portions of the pulmonary structure, but preferably, perhaps, the inferior and lower parts. In atelectasis, the parts affected are usually the margins of the lobes, or those portions most remote from, or not so readily accessibly by, the air. The color of the hepatized portions of the lung is of a yellowish or mahogany red, the surface is homogeneous, the contours of the vesicles are not visible, the hepatized structure is granular and friable, and, upon incision, there exudes from the surface a thin sanguinolent pus.(*t*) Finally, it cannot be inflated, the vesicular structure having become consolidated by a plastic effusion; whereas, in the case of atelectasis, the lung being merely in the fœtal condition, readily expands upon the insufflation of air.

§ 122. The most interesting *causes of imperfect respiration* are those which act by impeding the free access of air to the lungs.

(*t*) Legendre, Maladies de l'Enfance, Paris, 1846; Jacquemier, Accouchemens, vol. ii.

They may be divided into two classes, according as they act *before* or *after* birth.

The fact that respiration may take place *before* birth, comes to us attested by too respectable authority to be discarded as fabulous. However improbable it may seem that a child should breathe and cry while yet in its mother's womb, and however much the establishment of the possible occurrence of this phenomenon may perplex the question of infanticide, rendering evidence apparently the most convincing of no avail, we cannot hesitate to admit that this singular fact has been really observed. We find few writers at the present day denying it. It is reported that Velpeau has said that "he believed it, since it was asserted by learned and credible men, but that he would not believe it if he observed it himself." We subjoin the following cases in illustration. The first is related by Marc,(*u*) as communicated to him by Dr. Henry. "The 10th of October, 1824, I was desired by M. Jobert to assist him in an *accouchement* in which the pelvis was deformed in such a manner as to interfere with the delivery. Madame G—— was twenty-seven or twenty-eight years of age, and of a good constitution. Her two previous pregnancies were unfortunate; in both she miscarried. Upon our arrival, we found her in great suffering; the membranes had broken about forty-eight hours previously. I found the head of the child above the superior strait, the occiput turned to the right iliac fossa. The parietal bones alone had descended into the superior strait, and projected slightly into the pelvis; the *os uteri* was open to the extent of two inches. The deformity of the pelvis consisted in a very great prominence of the sacro-vertebral angle, and absence of curvature in the pubis, so that the antero-posterior diameter was diminished one inch, while the transverse was increased to the same extent. M. Jobert and I concluded to turn the child; but, however, as the head did not appear to be of a large size, we hoped to be able to disengage it by means of the forceps. This instrument was applied. At the moment that Dr. Jobert commenced to make traction, the fœtus cried distinctly for a dozen seconds, so as

(*u*) Dict. des Sciences Médicales (en 30 vol.), art. Infanticide.

to be heard by all present. The head remaining impacted, in spite of all our efforts, the forceps were removed. While we were conversing upon the necessity of performing the operation of version of the child the cries were again heard as distinct as the first, which could only be the result of several inspirations. And again, when I introduced my hand to search for the feet, in slipping it over the left shoulder, the fœtus, for the third time, gave vent to several cries, not so loud as the first, but sufficiently so to be heard by all the persons present. The delivery was accomplished with a great deal of difficulty, and the child breathed no longer; still, as the pulsations of the heart were pretty strong, we tried various means to restore it to life, and I endeavored to inflate its lungs. Our efforts were, however, of no avail, and the circulation ceased after a few minutes. I regret my inability to describe the condition of the lungs; but of what importance could it have been, as I had already introduced air into them?"

Landsberg gives a case of *vagitus uterinus* which occurred in his own practice. The first stage of labor had been unusually protracted, lasting, indeed, for nearly a week. At last, however, the membranes broke, and the child presented in the first position of the head. "At this time I, as well as some women standing at the bed-side, heard plainly repeated cries of a child, as if one were covered by the bedclothes." This was not the case, however; the room was searched, to ascertain if, perchance, a cat could be found, and finally all convinced themselves that the sounds really came from the yet undelivered child. The labor was brought to a termination by the application of the forceps. "The child was apparently dead, but soon revived, and is now living."(*v*)

§ 123. No mistake could be possible in the following case, reported by Dr. Kennedy, formerly Master of the Dublin Lying-in Hospital. He says: "I was called up one night by an intelligent pupil in the hospital, who informed me that a very strange sound was observed to come from a patient in labor, resembling exactly the whine of a child. On going into the labor-ward,

(*v*) Neue Revision der Lehre von der Athemprobe. Henke's Zeitsch. Erg. Heft. 38, 1849.

I found the nurses and pupils surrounding a patient's couch, with outstretched necks, listening with great intensity and amazement; and on approaching within about six feet of the bed, I distinctly heard a low moaning whine, resembling the faint and painful cry of a delicate seven months' child; this became more distinct the nearer I approached the patient, and there could be no doubt whatever that it came from the abdomen of the woman on the couch, however produced. Still sceptical, I applied the stethoscope, when the fact was proved beyond a doubt, as not only the cry mentioned, but the labored respiration of the fœtus was perfectly audible. A vaginal examination was instituted, and the head was found presenting, but high in the pelvis. The parts were only partially dilated, although the membranes were ruptured, and the waters had drained off shortly before. This woman was not delivered for four hours, and the above phenomena were observed by several of the pupils up to the time of the child's birth. The patient's name was Morell; the date of her delivery, 2d of December, 1830."

§ 124. Two other cases, of more recent occurrence, are related.(*w*) One of these occurred to Dr. Falkenbach, who, during the operation for turning for a cross birth, and while the child was undoubtedly within the uterus, heard it cry loudly several times, as did other persons in the room.

The other case is of still more importance, and occurred also during an attempt at version. The tone of voice was like that of a new-born child, only dull, as if it came from a cellar. It continued crying at intervals for two or three minutes. After this, delivery progressed rapidly, until the shoulders arrived in the pelvis, which was rather narrow, while the child was a large one. The child was born dead, beyond recovery. Its cries, while in the womb, were heard by three other people in the room, as well as by the midwife, who was hard of hear-

(*w*) Brit. and For. Med. Chir. Rev., Jan. 1850, from Med. Zeitung, Nos. 20 and 30. Another case has been still more recently reported by Dr. Knüppel. In consequence of a cross position, the child was turned, during which operation vagitus was distinctly heard. It was, however, born dead. The lungs were of a pale red color, filled the chest completely, crepitated on incision, and swam in water. Canstatt's Jahresbericht für 1853. VII. Bd. p. 19.

ing. The chest was examined twenty-four hours afterwards, and was found to be well expanded. The lungs partly covered the pericardium. They were removed, in connection with the heart and thymus gland, and being placed in a basin of cold water, *swam* completely. The lungs were of a bright-red color, with bluish spots here and there. They crepitated on incision, and some foam and a little blood flowed out. When cut under water, large air-bubbles rose to the surface: not the smallest portion of the structure sank. This last case is, except that in note (*w*), we believe, the only one in which the lungs, in a case of uterine vagitus, have been submitted to the hydrostatic test; and hence, from it, we have undoubted proof of the possible occurrence of uterine respiration, and an increased probability of the observations in the previously related cases having been accurate. Two cases are related by Kirby,(*w*[1]) and another by Kristeller.(*w*[2]) In the latter, resuscitation was accomplished after apparent death.

§ 125. We have assumed that uterine respiration must be *imperfect*, a position which seems to be contradicted by this case; but we find it stated by the author that "the air cells of the periphery had not become completely filled with air," a fact which we will not undertake to reconcile with the statement that no part of the lungs sank in water.

§ 126. The extreme rarity of uterine and vaginal respiration and *vagitus* is evident from the few authentic cases upon record, as well as from the incredulity with which the fact has been received by some authors. Moreover, certain obstetricians of most extensive experience state that they have never witnessed this phenomenon, and Baudelocque and Capuron declare that even in cases where the face and mouth of the child presented at the vulva, giving a favorable opportunity for the access of air, they have never observed it. We are not able to define the causes which favor its occurrence in some cases and not in others, nor explain how the air could gain access to the lungs in cases like those above narrated, and in others which might be referred to. All that can be safely asserted is, that

(*w*[1]) Bayer, Austzl. Intell. Bl., 1865.
(*w*[2]) Prag. Vjhrsschrft, 88, p. 121.

this phenomenon never occurs before the rupture of the membranes and the dilatation of the mouth of the womb, and that it has been observed, as yet, only in tedious labors, or when the hand of the accoucheur has been introduced to assist the delivery. Dr. Beck relates two cases in which it was distinctly perceived under this latter contingency. It is not, however, a necessary element for its production. As vagitus uterinus has only been noticed in lingering and assisted labors, which characters hardly ever pertain to concealed deliveries, Casper thinks that this disputed physiological rarity need not enter into the question which a medical expert is called upon to answer.

§ 127. Another, and in its practical bearings more important condition, under which imperfect respiration may take place before birth, is after the delivery of the head, while the body yet remains in the vagina and the womb. It is undeniable that in this position the child often breathes and cries. The delivery of the body may be retarded by various circumstances, the principal of which are a too great size of the shoulders, a sudden cessation of the expulsive pains, and compression of the neck of the child by the umbilical cord. The fact, as above stated, is beyond all cavil, and Ritgen, a German obstetrician of high standing, from the frequency with which he has observed it, considers it not even exceptional. It will be readily seen how much doubt this fact may cast upon the question, whether the child has been born alive. It may breathe before it is fully born, and yet, as it is not accounted by the law to be born until *fully expelled* from the mother, fatal violence exercised upon it in this situation has been adjudged not to constitute the crime of infanticide. We shall allude more in detail to this fact under "*Causes of death in new-born children.*"(w^3) In the same place will be found an account of those causes of imperfect respiration which act *after* birth. It sometimes happens that after the delivery of the head of the child, and after it has breathed and cried, its respiration is impeded, and may be arrested by the pressure of the umbilical cord encircling the neck. The cord may be wound

(w^3) § 140 *et seq.*

several times around the neck, so tightly as to render its disengagement without severing it, impossible, and hence, after the delivery the child may be incapable of resuscitation, and, in some rare cases, even bear upon its neck the marks of strangulation, and in its lungs the evident signs of its having respired. If, under such circumstances, the birth is not witnessed by a competent person, suspicions of having inflicted a violent death upon her offspring may unjustly attach to the mother.(w⁴)

§ 128. 2d. *Tests of live birth.*—The most important of the proofs of live birth, which, from their general application, have been called "tests," are derived from an examination of the absolute and the specific weight of the lungs. Although the data yielded by them are said to prove *life*, they do so only incidentally, by proving respiration; and although, in criminal practice, it is requisite that the fact of respiration should be established, yet it is important to bear in mind that there may be *life without respiration*. The circulation may go on, and the child may make various muscular movements, after it is separated from the mother, without respiring. Sometimes, owing to congenital feebleness, or to its being in an asphyxiated condition, it makes no effort to breathe; and again, all its efforts may be fruitless, from the obstruction of the fauces and larynx with viscid mucus. Hence, paradoxical as it may seem, a child may live and die without having breathed. In such a case, the lungs will, of course, reveal no trace of respired air.(x) The attempt too strictly to define the essential conditions of life has led to some absurd conclusions. In Germany, a distinct vocal sound is required by law as the evidence of life. But this appears to be modified in practice by the substitution of breathing for vocal sound, and the doctrine is accepted that respiration and

(w⁴) *Vide infra*, § 150.

(x) This fact was urged as an objection to the hydrostatic test by the Wittemberg Faculty (Valentin's Pand. Med. Leg., p. ii. sec. vii. chap. 12, p. 583, ed. 1701), at the very beginning of its application to medical jurisprudence. We have ventured to depart from the custom of medical writers on this subject in treating of it under this head, because the object of the hydrostatic test is to ascertain whether the child has breathed, and not to determine the fact of its having lived without respiration.

life are reciprocally evidences of one another. According to this doctrine, intra-uterine life is not life in the sense of life after breathing. Plants, and those animals which breathe by the skin or by gills, do not, according to it, really breathe. But if we admit that breathing essentially consists in the act or acts by which the effete circulating fluids of a living creature are renovated, we shall see that life is consistent, not only with very dissimilar modes, but also with very irregular degrees of that renovation. The fœtus in utero, while still inclosed in its membranes, has its blood renovated by juxtaposition with that contained in the maternal bloodvessels, and thus, indirectly but substantially, it breathes through the lungs of its mother. Although the mechanism of its respiration is different from that which will exist after birth, its essence and effect are the same. Again, even in the adult, examples are constantly met with of life without perceptible breathing, as in syncope and trance, states in which it is true that life is probably sustained by the exchange of the foul air in the lungs with the pure external air, under those laws which regulate the diffusion of gases. Yet in the popular sense there is no respiration, although there is life, and a life which, indeed, is generally manifested by the sound, however feeble, of the heart's pulsation. The new-born child, therefore, although it presents the aspect of death, is not necessarily dead; its near approach to lifelessness may even become the means of saving its life under circumstances which would infallibly have produced suffocation and death, had respiration been complete.

§ 129. The following may serve as illustrations of the statement just made. Weese reports the case of a female who was rapidly delivered of a child in a tub, and, believing it to be dead, buried it in a sand-pit, where it remained for half an hour, but was then disinterred and restored to life. In another case, at Berlin, the child, supposed to have been born dead, was buried for the space of an hour, but was resuscitated. In a third instance, a child apparently born dead, and so considered after an hour vainly spent in efforts to resuscitate it, was then abandoned for several hours, after which it was inclosed in a coffin and placed in a cold chamber (it was the month of Jan-

uary), near an open window. Twenty-three hours after its birth the body was quite cold, but free from discoloration or stiffness. Owing to the latter circumstance the heart was examined, and, being heard to pulsate, renewed attempts at resuscitation were made. But finally all signs of life ceased. On dissection the lungs sank in water both in mass and in fragments. Another instance is still more remarkable, from its result. A woman buried her illegitimate child, which she supposed to be stillborn, nine inches under ground, and with the face downwards. It remained thus between four and five hours, when it was exhumed, resuscitated, and lived three days.(*y*) A case nearly identical with this is referred to by Briand, who, however, states that the life of the child was preserved.(*z*) It is, then, quite possible that life may have existed in spite of every reasonable presumption of its absence, founded upon an inspection of the child both before and after its certain death.

§ 130. If the argument should ever be used in any case of infanticide, that the violence was inflicted upon a child which had lived without breathing, it would have to be sustained by other testimony or evidence than that of a medical expert; since there is no medical proof of extra-uterine life, independent of respiration. Hence, the commission of infanticide, by submerging a child in water before it has breathed, or the exclusion of air from it in any other way in which no external mark is left, deprives the medical examiner of the means of deciding whether the act was committed upon a living child; because, we repeat, the lungs remain in the same condition after as before birth, provided respiration has not taken place, and, in the short interval of existence possible under such circumstances, no other change could occur which could be relied upon as an indication of extra-uterine life.(*a*) It would appear that the effort to breathe, although unsuccessful in inflating the lungs, may, nevertheless, modify the circulation of the blood so as to leave certain proofs of the fact. These, which

(*y*) Maschka, Prager Vierteljahrs., 1854, iii. s.
(*z*) Médecine Légale, 6ème éd., p. 209.
(*a*) Henke's Lehrbuch, 12th ed., p. 341.

were first pointed out by Tardieu,(*b*) are what Casper has denominated *petechial suggillations*, and which he describes as capillary extravasations of blood beneath the pleura and the lining membrane of the aorta and the heart.

§ 131. Liman describes these ecchymoses under the pleuræ and other serous investments, as varying in size from that of a pin's head to that of a hempseed; they remain attached to the serous membrane when it is stripped off, nor can they be removed by washing. Liman does not think, with Tardieu, that they are a certain sign of asphyxia, and, though most common in suffocation, they furnish no clue as to the mode of its production. Their occurrence is accounted for by the theory that the powerful inspirations overcome the resistance of the capillaries. While their presence is an important sign of death from suffocation, their absence does not furnish equally strong proof that death has not occurred in this way.(*b*[1])

In a case quoted from Hecker, there was prolapse of the cord, and, the introduction of the hand to effect version of the child having necessarily compressed the cord, and thereby suspended the circulation through it, several inspiratory movements of the child could be distinctly felt. It was not, however, born alive, and extravasations like those just described were discovered on dissection. Similar observations have been made by Hohl, in cases of foot and breast presentation when the head was detained in the uterus or vagina; the inspiratory movements of the chest were frequent and vigorous, the children nevertheless were born dead, and the pleura and heart presented the ecchymoses referred to, and the lungs sank when placed in water.(*c*) It may naturally be inferred from what has now been stated, that, if any cause interrupts the fœtal circulation during labor, an inspiratory effort will be made, and, if the mouth and nose of the child are still immersed in liquor amnii, this fluid will tend to enter the respiratory passages. Dr. Briesky has published four cases,(*d*) in which the heart of the fœtus was heard during labor, but life was extinct at birth. In all of them the air-passages were filled with

(*b*) Annales d'Hygiène, 2ème sér., iv. 379. (*b*[1]) Casper, vol. xix. p. 73.
(*c*) Gericht. Med., i. 706. (*d*) Prager Vierteljahrs, 1859, iii. 175.

liquor amnii more or less tinged with meconium. In the first case the cord had prolapsed, as in the example already cited, and had been subjected to pressure, so as to favor the inspiration of the liquid; in the remaining three an analogous cause within the uterus may be surmised to have existed, but could not be demonstrated. In all of these cases extra-uterine life was rendered impossible by a physical obstacle in the lungs preventing the access of air to these organs.

§ 132. (1) *Hydrostatic lung test* (*Docimasia pulmonum hydrostatica*).—This is an experiment in which the lungs of a newborn child are placed in a vessel containing water, in order to judge from their *specific gravity* whether or not the child has breathed.(*e*) Its first application in medical jurisprudence was made by Dr. Schreyer, of Zeitz, although the principle was known, it is said, by Galen. The experiment is conducted in the following manner. The lungs are carefully removed from the chest, with the heart attached or not, but always in connection with the trachea. They are then placed upon the surface of pure water. If they float, the evidence is very clear that they contain air, and the higher they float the more perfect has their expansion been. If, on the contrary, they sink to the bottom, the evidence is equally plain that they contain air to a very imperfect extent, if at all. In order, however, to judge fairly of their degree of buoyancy, and to ascertain how much and what parts of the organs contain air, a further investigation is required. The thymus gland, with the heart and pericardium, should be removed with care, to avoid injuring the pulmonary tissue, after which the lungs should be again put in the water. Each lung should then be tried separately, and finally divided into small pieces, and each of these thrown by itself into the water, before and after compression between the fingers. By carefully observing the results elicited by this experiment, satisfactory proof of the presence or absence of air in the lungs may be acquired. At this stage of the inquiry no further inference is allowable; we can neither say that the child has lived and breathed, because its lungs float

(*e*) Valentin, Pand. Méd. Lég., Par. ii. sec. vii. p. 502. "De infanticidio per-pulmonum in aquam project. subsident. elidendo."

on the water, nor deny that it has lived if they sink to the bottom of the vessel. And yet this experiment must always retain its great importance in cases of presumed infanticide. Restricted within its proper limits and sources of error properly guarded against, there is no medical test so simple and conclusive.(*f*) As Dr. Taylor remarks, "the law holds, under the decisions of its expounders, that respiration is only *one*, and not an exclusive proof of life."(*a*)

§ 133. The objections made to the hydrostatic test are founded upon two facts:—

1st. That the air which gives buoyancy to the lungs may have been derived from other sources than natural respiration; and,

2d. That notwithstanding the absence of demonstrable air from these organs, the child may have lived. The sources from which the air may have been derived are, Putrefaction, Emphysema, and Artificial Inflation.

Putrefaction.—At an undetermined stage of the putrefactive process, gas is disengaged by the decomposition of the blood contained in the lungs, and sometimes in sufficient quantity to give buoyancy to the whole or a portion of them. The air thus evolved is, however, not contained in the pulmonary vesicles, but in the cellular tissue, and chiefly between the lobes and on their margins. Here it is seen collected in rows of bubbles, much larger than the air-vesicles, prominent, and easily disappearing under slight pressure. At the same time, the lungs present other signs of the putrefactive process, in their greenish color, diminished consistence, and fetid odor. The period at which the putrefactive vesicles are developed is not accurately known, and is influenced by circumstances, as, indeed, are all the other incidents of putrefaction.

§ 134. It is a fact, however, worthy of remark, that this process is set up later in the lungs than in most of the other organs of the child. This fact is attested by many writers, and particular stress is laid upon it by Dr. Casper. In four cases examined by this author, where the child's body was already greatly

(*f*) De usu partium corp. human., lib. xv. cap. 6.
(*a*) Med. Jurisp., 6th ed., p. 451.

decomposed, the lungs retained their firmness and dark-brown color, and sank in water. In one case the heart and liver were both covered with putrefactive vesicles, and swam upon the surface of the water, while the lungs, which were firm and brown, sank to the bottom.(*b*) I have, myself, frequently found the lungs of new-born children entirely unchanged in color, consistence, and appropriate hydrostatic relations, when at the same time the brain was reduced to a mere pulp, the abdomen thoroughly putrescent, and the epidermis peeling from the whole body. The striking changes which attend the commencement of decomposition in the lungs cannot permit an error on the part of the examiner. Should the buoyancy of the lungs be due to putrefaction, by the development of spurious air-vesicles upon the pulmonary tissue, the fact may be easily recognized, and ascribed to its real cause. Should, however, no signs of putrefaction in the lungs be found, and yet these organs float, the objection is theoretical merely, and not at all pertinent. The obvious inference is, that the objection cannot be urged, when there is no proof of its applicability to the case in hand. It is not unnecessary to press these apparently simple truths upon the attention of the reader, for every day's experience in forsenic medicine attests the false importance attached to irrelevant objections. When the above-mentioned changes have supervened in the lungs, they can no longer be used in evidence, since the buoyancy of these organs may be due to air derived either from decomposition or from respiration. A discrimination between the two at this period is manifestly impossible.

§ 135. *Emphysema* was formerly distinguished from putrefaction, as a condition giving buoyancy to fœtal lungs. It may safely be asserted that no such condition is found in lungs which have not respired. It is probable that the older authors mistook for it the appearances presented by putrefaction. Drs. Cummin and Lecieux(*c*) speak of a "sort of contusion suffered

(*b*) Casper's ger. Leich. öff. 1 and 2 Hundert, Fälle 67, 68; 65, 66.

(*c*) The Proofs of Infanticide, by Wm. Cummin, M.D., p. 61. Consid. Méd. Lég. sur l'Infanticide par Lécieux; *vide* also, Schmitt, loc. cit.; Versuch 32; S. 41 and 212.

by the lungs in difficult labors, to which they attribute the development of air in large vesicles on their surface," while the lungs presented at the time no signs of putrefaction; but these observations have not been confirmed by others. Mr. Taylor(*d*) says, that in examining the bodies of many stillborn children, he has never met with any appearance resembling what has been described as a state of emphysema, independently of respiration and putrefaction.

Toulmouche(*d*[1]) regards the occurrence of emphysema as very rare, and says, that when present, it is *never* sufficient to give buoyancy to the lungs of a fœtus which has not breathed.

Casper is equally decided, saying, "that as yet, not one single well-observed and incontestable case of emphysema, developing itself spontaneously within the fœtal lungs, is known, and it is, therefore, not permissible in forensic practice to ascribe the buoyancy of the lungs of new-born children to this cause."(*d*[2])

§ 136. The last objection to the inference that the lungs must have respired if they float on water, is found in the fact that *Artificial Inflation* will cause the lungs to float. If the lungs of a stillborn child be fully inflated by means of a tube, they increase rapidly in volume and acquire a dirty yellowish-red color; when the insufflation is discontinued, they immediately collapse, but still retain enough air to enable them to float. The effect of strong pressure in expelling this air, is, according to my own experience, which corresponds very nearly with that of Dr. Guy, almost similar to that in lungs which have respired. Nothing short of a strong and continued pressure will cause them to sink; and the compression in the one case is so nearly what is required in the other, that the difference is practically unimportant. If, however, an attempt be made to introduce air into these organs, in the only manner in which it is important to consider its effects, viz., by insufflation through the mouth of the child; the greater part of the air passes into the stomach, while a very incon-

(*d*) Loc. cit., p. 303, Am. ed.
(*d*[1]) Ann. d'Hyg. xvi. 364 and xviii. 157.
(*d*[2]) For. Med., N. Syd. Soc. Trans., vol. iii. p. 72.

siderable portion, and sometimes none at all, reaches the lungs. Mr. Taylor says that he has had several opportunities of examining the lungs in children, where inflation had been resorted to, not for the express purpose of creating an objection to the hydrostatic test, but with the *bonâ fide* intention of resuscitating them. In some of these instances a tube had been used, in others the mouth. In the first case it was found, on inspection, that only about one-thirteenth part of the structure of the lungs had received air. In the second, no part of the lungs had received a trace of air, although inflation had been repeatedly resorted to; the air had passed entirely into the abdomen. In a third, attempts were made for upwards of half an hour to inflate the organs; but, on examination, not a particle of air was found to have penetrated into them. In a fourth, no air had entered the lungs; and in a fifth, although a small portion had penetrated into the organs, it was readily forced out by compression. In repeatedly performing the experiments upon dead children, the results have been very similar; the lungs, after several attempts, were found to have received only a small quantity of air.(*e*)

§ 137. On the other hand, Schmitt, of Vienna,(*f*) has made numerous experiments, from which he has drawn the following conclusions:—

1. That it is possible to inflate the lungs of stillborn or asphyxiated children.

2. That the insufflation succeeds easily and completely, if done in the proper manner, and if there is no mechanical obstruction to the entrance of the air.

3. That the inflation is imperfect and difficult, and even entirely fails, when the respiratory passages are filled with mucus.

4. That the increase of volume, the spongy texture, the rosy color, and the buoyancy of the inflated lungs, vary according to the degree of success of the operation.

(*e*) Med. Jur., p. 305, Am. ed.

(*f*) Neue Versuche und Erfahrungen über die Ploucquetische und hydrostatische Lungenprobe, Wien, 1806.

5. That lungs properly inflated are crepitant, like those which have respired, and yield frothy blood on incision.

6. That inflation increases the convexity of the thorax.

7. That it does not increase the weight of the lungs in a child which has not respired, and that, in the great majority of cases, the same relation exists between the weight of the lungs and the body after insufflation as in the fœtus which has never breathed.

§ 138. The results obtained by Mr. Jennings(*g*) are equivalent to those of Schmitt.

Dr. Elsässer concluded, after a large number of carefully conducted experiments, that the insufflation of the lungs through and by the mouth is possible. We find, however, that he really succeeded only in one instance out of fifty-two cases, and in one case it is stated *that the child made six distinct efforts to respire.*(*h*)

§ 139. Dr. Browne, of King's College Hospital, endeavored to resuscitate a stillborn child by artificial respiration, having failed with other means. He closed the nostrils with the thumb and forefinger of the left hand, and grasped the breast and body of the child with the right. Placing his own mouth upon that of the child, he continued to breathe into it for ten minutes, imitating by pressure with his hand the natural movements of respiration. He failed, however, to revive the child. Upon inspection of the body, the lungs were found fully expanded, of a pale-red color, buoyant, and frothy upon incision. Cut into pieces, however, and subjected to compression, they sank in water.

Dr. Roth(*i*) performed this experiment upon a stillborn female child, twenty-four hours after birth. Having previously removed the anterior wall of the thorax, in order to observe the changes produced by the insufflation of air by the mouth, he saw that upon the first insufflation the lungs began to expand, and that they acquired a clear red color in spots upon their surface. By continuing the inflation, this color

(*g*) Trans. Prov. Med. and Surg. Association, vol. ii. p. 440.

(*h*) Untersuchungen über die Veränderungen. etc., durch Athmen in Lufteinblasen, Stuttgart, 1853.

(*i*) Henke's Zeitschrift, 1850, 4 H.

spread all over the lungs. At the same time the stomach became so distended with air, that he was obliged to discontinue the experiment, from the fear that this organ would burst. The difference between these lungs and those which had breathed, he states, consisted in the fact that their expansion was less, the color of a brighter red, and the buoyancy and crepitation less. He succeeded in expelling the air from them by compression, and then they sank in water.

§ 140. Our own opinion upon the possibility of a successful inflation of the *lungs in situ* does not differ from that of the most recent and best authorities upon the subject, viz., that the lungs cannot be fully inflated by this means in such a manner as to resemble, in their appearance and hydrostatic relations, lungs which have perfectly respired. Those cases where the resemblance appears to have been very close may be explained upon the assumption that the child was not completely passive under the experiment, but retained sufficient vitality to make, during it, and unperceived by the physician, one or more efforts at inspiration. That the lungs of a dead child can be wholly inflated *in situ*, and made to resemble those which have naturally and fully breathed, is, we believe, at variance with the experience of the great majority of those who have given their attention to the subject.

The fact that pressure will expel the air from lungs which have been inflated *through the mouth*, while no compression less than what would destroy completely the pulmonary tissue will avail to force it from those which have fully inspired in the natural way, is the chief and most reliable distinction which can be made between the two cases. The most reliable test of breathing, derived from an examination of the lungs, is, however, that which has been given by Briand and by Casper. However successful the inflation of these organs may be, their surface will never present the peculiar dark marbling described above as a sign of respiration, unless this act have been performed by the natural mechanism. The reason of the difference between the appearances in the two cases is a simple one. Natural respiration is an act which tends to create a vacuum in the lungs, and consequently to draw into them the blood of the pulmonary arteries which gives them the comparatively

dark-bluish and marbled aspect alluded to; but artificial respiration, by which air is forced into the lungs, tends, by the pressure of that air, to exclude the blood, and consequently to render the color of the lungs still lighter than before. But in judging of the value of this test, it is important to recollect that its applicability is limited to cases in which the distension of the lungs is considerable. The less they depart from the fœtal state, the less does its value become.

§ 141. It must be admitted, however, without the least reserve, that the effects of artificial inflation cannot be distinguished from those of *imperfect respiration*. Although the distension of the stomach and intestines with air is an inevitable accident in artificial inflation, it cannot be relied upon as a diagnostic sign, since it may be merely a cadaveric phenomenon. Its *absence*, indeed, in a case where it is supposed that these means had been used, would, of course, disprove the supposition. A distinction might, perhaps, be hoped for from the employment of Ploucquet's test, since the artificial filling of the lungs with air increases their volume alone, without altering their absolute weight; while natural respiration, being attended with a circulation of blood through the pulmonary vessels, increases their weight and volume together. But it will be seen further on that the results attained by Ploucquet are too variable and uncertain to be used where a distinction of so delicate and momentous a nature is required. The question can be disposed of only in one manner. If other evidence can establish the presumption that artificial inflation has been attempted, the physician must then be ready to answer whether the results of his examination are such as to justify and support this presumption. But if, on the other hand, no such evidence is offered, we do not see how it can be required of the physician to take into consideration the possibility of a manœuvre which he knows can be effected only by skilful and careful professional management, and which, moreover, the nature of the alleged crime renders in the highest degree improbable. From the prominence usually given to this objection to the hydrostatic test, one might be led to suppose, as Mr. Taylor justly remarks, "that every woman tried for child-murder had made the praiseworthy attempt to restore

a stillborn child, although circumstances may show that she had cut its throat, severed its head, or strangled it while the circulation was going on."

§ 142. Casper coincides with those who maintain the very great difficulty experienced in successfully inflating fœtal lungs; and thinks that a distinction is very perceptible between lungs inflated naturally and those in which the effect has been produced by artificial means. He states the case as follows: "When we observe a sound of crepitation without any escape of blood-froth on incision, *laceration* of the pulmonary cells with hyperæmia, *bright cinnabar-red* color of the lungs *without any marbling*, and perhaps *air* in the (artificially inflated) stomach and intestines, we may with certainty conclude that the *lungs have been artificially inflated.*"(*i*[1])

§ 143. It is asserted by Bouchut,(*i*[2]) that, if the lung of an infant which has respired be examined with a lens, the surface of each lobule appears as a collection of very distinct rounded vesicles, each having a luminous point, which are wedged together and vary in size, while in the lungs of those stillborn no such appearances are present.

Guy (*i*[3]) does not hesitate to give the first and highest place among the tests of respiration to the development of the air-cells, which is very manifest to the naked eye. This development first takes place on the upper edge and concave surface of the right lung, and presents a very characteristic appearance. "If the lungs are fresh and full of blood, the air-cells assume the form of brilliant vermilion spots; if they contain less blood, or are examined some days after death, the spots are of a lighter color; and in children who have survived their birth some days they have very nearly the hue of the healthy adult lung." Their form is angular, not raised from the surface, and they are evidently in the substance of the lung near the surface. They are in general irregularly grouped, though sometimes arranged symmetrically.

§ 143a. Having now examined the conditions which will

(*i*[1]) For. Med., N. Syd. Soc. Trans., vol. iii. p. 68.
(*i*[2]) L'Union, July 31, 1862, p. 211.
(*i*[3]) Principles of Forensic Medicine. London, 1868.

cause the lungs of a new-born child to float when submitted to the hydrostatic test, it remains for us to notice briefly those which will cause them to sink and to remain at the bottom of the vessel, as in the fœtal condition. *Disease* of any kind which increases the density of the pulmonary structure will cause them to sink, or rather that portion of them affected thereby. *Pneumonia*, or inflammation of the lung, so increases the density of pulmonary structure as to cause it to sink in water. It is rare, however, that pneumonia occurs congenitally, and it does not necessarily involve the whole lung; hence portions of it may be found to be buoyant. It has been asserted that a very great *congestion of lungs* which have already respired will destroy their buoyancy, but this fact has been clearly disproved.(*j*) We need hardly say, that, if the structure of the lungs be so diseased that they will sink in water, the cause cannot fail to be evident. Reference has been previously made to that condition of imperfect expansion of the lung called *atelectasis*. Occasionally the lungs contain such a trifling amount of air, that it is not sufficient to float the whole of the organ, and life and respiration may exist without bringing about the usual changes in the pulmonary tissue. We are obliged, moreover, to admit, on the authority of credible writers, the fact that life and respiration may be prolonged for a considerable time, and yet on *post-mortem* examination, the lungs, either whole or divided, sink in water. Such instances have been met with by trustworthy German writers.(*k*) In two cases which came under Böcker's observation the children were born by the head, and without difficulty. Movements of the limbs, the sounds of the heart, and the pulsations of the umbilical arteries were perceived, but no act of breathing; and after death, which took place speedily, the lungs sank in water even when cut into small pieces. In a third case no movements were made by the child, but the heart and the cord pulsated for two minutes, and the lungs gave the same results, on being tested, as in the previous cases. These results have been strikingly

(*j*) *Vide* Schmitt, loc. cit.

(*k*) Remer, Bernt, Schenck, Osiander, Meckel, Böcker.

confirmed by the experience of Dr. Taylor. He says:(*l*) "I may add to these instances two which have occurred under my own observation. In one, the case of a mature male child, the lungs sank in water, although the child had survived its birth for a period of *six hours*. In the other, the case of a female twin, the child survived *twenty-four hours*, and after death the lungs were divided into thirty pieces, but not a single piece floated; showing, therefore, that, although life had been thus protracted, not one-thirtieth part of the structure of the lungs had received, from respiration, sufficient air to render it buoyant." Now, although these results conflict with general experience, and are not clearly explicable upon any known physiological ground, they must be allowed to have their weight. Hence, if a child's lungs sink in water, and no disease be found by which the fact can be explained, we cannot infer that the child has not lived, nor even that it has not breathed, although the respiration must have been exceedingly restricted. Hence, in this case the hydrostatic test can give us no positive proof of the non-occurrence of respiration. This certainly is a matter of regret; but although it does not always enable us to attain the truth, and detect criminality, it does not, on the other hand, cause the life of an innocent person to be placed in jeopardy. It is merely an imperfection in the test, and affords no ground for an objection to its application in other cases in which it undoubtedly is capable of affording positive and useful knowledge.

§ 143*b*. Falk contributes an elaborate article to *Horne's Vierteljahrsschrift*, x. p. 1, 207, upon the lungs of new-born children, the conclusions of which may be summarized as follows: (1) Color may vary from black to white. (2) In early fœtal life they are pale red and become darker; but we cannot estimate uterine age from them. (3) When no air has been inspired, the color is dark blue, as a rule; when air has been inspired, bright red. (4) But the light may become dark and the dark colored light without furnishing evidence that the lungs are airless, or the contrary. (5) Consequently the marbling of Casper is not proof *per se* of extra-uterine life, though

(*l*) Medical Jurisprudence, Am. ed., p. 300.

it always obtains a short time after birth. (6) More important is the fact that in the air-lung a network of vessels around the alveoli is perceptible, while the alveoli, being filled with air, look like pearly vesicles. If this condition is met with in part of the lungs, it proves respiration, (?) as premature attempts at breathing rarely introduce air. (7) This mosaic marking can be made out in anæmia or plethora by a lens. (8) Anæmia of lungs is evidenced by a pale color, hyperæmia by a dark-blue color. (9) In hyperæmia the color is diagnostic between congestion and post-mortem hyperstasis. (10) Putrefaction produces a dark color in both air and fœtal lungs, and the distinction between the two first becomes impossible from the formation of vesicles and the falling apart of the tissues from advanced decomposition. (11) White hepatization makes fœtal lung brighter, like anæmic air lung, and the hydrostatic is the only test. (12) Red hepatization draws the two appearances together, and the color ceases to be a test. (13) The lungs do not change color much, and there is no characteristic tint immediately after birth. (14) When air has been introduced by artificial respiration, it looks much like an anæmic lung, and the proof of color is uncertain. Such cases are, however, rare in foro.

While we have thought it best to present the above as among the most recent contributions to the subject under consideration, we are very far from indorsing some of the conclusions of their author, and regard some of his diagnostic refinements as unlikely to be of value in medico-legal cases.

§ 144. (2) *Static tests* are founded upon the observation that the lungs of children who have breathed are heavier than the fœtal lungs. This fact has been ascertained by direct experiment, and is attributed to the blood, which, as soon as the child makes the first attempt to breathe, enters the lungs. In proportion, therefore, to the degree of the pulmonary expansion will be the weight of these organs. Now, it is obvious that if a constant average weight of the lungs before and after respiration could be ascertained, drawn from numbers which fluctuated but slightly, it would afford a useful standard of comparison by which we could judge whether a child had really lived and breathed. For if, as was estimated by Daniel,

the weight of the lungs after respiration was constantly augmented to the amount of two ounces, and this could be established as the general rule, there would no longer be any difficulty in deciding the knotty question of live birth. Observations, however, have satisfactorily shown that no such constant average weight of the lungs exists. These organs in some mature stillborn children actually weigh *more* than in those who have enjoyed full and complete respiration, and in this respect the difference is not more singular than is the great variation in size and weight of the whole body in healthy children born at full time.

§ 145. The second form of the static test, advocated by *Ploucquet* in 1782, and usually named after him, is quite as uncertain as the foregoing one. It is founded on a comparison of the absolute weight of the lungs with the weight of the body. Ploucquet having made a few experiments respecting the proportion existing between them, fixed the average at 1.70 before respiration, and at 2.70 after it; in other words, he considered that the lungs, after breathing, weighed nearly twice as much as they did before. The repeated and numerous observations since made by Jäger, Schmitt, Lecieux, Chaussier, Orfila, Taylor, Guy, and Beck, have clearly proved that any constant ratio, like that assumed by Ploucquet, is illusory and inexact.

According to Elsässer, the congenital differences in the absolute weight of the lungs are far greater than those in the absolute weight of the body. Thus, in 68 stillborn mature children, he found the average weight of the lungs to be 13 drachms 18 grains. The *maximum* weight (in perfectly normal lungs) was 20 dr. 35 gr. The *minimum*, 8 dr. 35 gr. Hence the difference or variation was 12 drachms, which almost equals the average weight. The average weight of the body in these 68 children was 7 lbs., and the difference between it and the greatest weight did not amount to *one*-half of the average weight.(*m*)

§ 146. The relative weight of the lungs and body varies in different individuals, according to sex, peculiarities of confor-

(*m*) Loc. cit., p. 96.

mation, and other circumstances. Almost every author who has experimented with a view of ascertaining a fixed average ratio, has adopted a different one from his predecessor, and the conclusion appears to be generally admitted that the test is not reliable. In conclusion, we may remark, that, if these static tests are not worthy of dependence in those cases where the child has *fully* respired, still less are they to be relied upon where the function of respiration has been *imperfectly* established. It is in the latter cases, that, practically, the great difficulty of a correct judgment lies; the former are much more satisfactorily determined by the hydrostatic test.

§ 147. The following are the chief points which have now been demonstrated:—

1st. That, although respiration is conclusive evidence of life, it may take place previous to birth.

2d. That life for a brief period is compatible with absence of respiration.

3d. That none of the mere anatomical proofs of live-birth are satisfactory, when taken singly.

4th. That, even when combined, they fall short of demonstration.

5th. That the result of the hydrostatic test may (in some as yet unexplained cases, as where the lungs sink in water although the child has breathed) be negative in its character.

6th. That the hydrostatic relations of the lung afford evidence in reference to respiration which, especially when confirmed by the static tests, is exposed to few real sources of error.

7th. That the objections to the hydrostatic test are mainly theoretical.

8th. That the burden of showing their applicability rests with the objector.

From an analysis of the evidence furnished by an examination of the lungs in the cases which have been considered in the present article, Casper arrives at the following conclusions. A child may be regarded as having breathed during or after birth—

1. If the upper surface of the diaphragm is between the fifth and sixth ribs.

2. If the lungs fill the cavity of the chest more or less com-

pletely, or at least do not require a separation of the incised ribs to render them visible.

3. If the predominant color of the lungs is mottled by patches.

4. If the lungs, on careful trial, are found to float upon water.

5. If moderate pressure of incised portions of the lungs causes a bloody froth to exude.(*a*)

It has been proposed to draw certain inferences as to the life of the child from the contents of the stomach. If this organ contains milk, starch, or sugar, there can be no doubt of its having lived after birth. In other cases innutritious substances have been found in it, affording an equally positive reason for concluding that the child was born alive. In a case reported by Märklin(*b*) of an infant's body found in the Rhine, its stomach, intestines, and air-passages contained a certain quantity of the sand which the water of this river holds in suspension, and, although its lungs were completely empty of air, it was concluded that the sand could not possibly have reached the organs in which it was found without an active movement of swallowing, and therefore not without the child had lived.

§ 148. Schwartz and Krahmer have shown that when the circulation in the placenta is stopped in any way the fœtus experiences a "besoin de respirer," and inspires. If the mouth has access to the air we may have vagitus uterinus, if not, liquor amnii, meconium, and vernix caseosa may be drawn into the lungs and stomach, as deglutition is generally isochronous with respiration; but if neither fluid nor air have access to the mouth, the effort to inspire results in drawing blood into the pulmonary and other intra-thoracic vessels with such rapidity that extravasations occur, chiefly as sub-plural ecchymoses, so that when we find these so-called petechial ecchymoses under the thoracic serous membranes, with the above-mentioned foreign substances in the air-passages, we may safely conclude that the fœtus was exposed, before birth was completed, to dangers which were likely to cause death, such as pressure upon the cord.

(*a*) Gericht. Med. i. 767. (*b*) Casper's Vierteljahrs. xvi. 26.

Böhr says that death may have thus resulted and yet the petechial ecchymoses may be wanting. By themselves they do not prove respiration. It would appear that they are in practice rarely combined with foreign substances in the air-passages, as blood is drawn most forcibly into the chest when no fluid, such as meconium, etc., has access to the mouth. Again, petechial ecchymoses do not prove death before birth, as they may be recovered from and death from other causes ensue; they are, however, more dangerous than the inspired fluids spoken of. Indeed meconium is found quite often below the bifurcation of the bronchia, *when looked for.*

It is evident that the examination of these points will clear up many cases in which infanticide is suspected. It may be safely stated that the highest authorities concur in regarding the *hydrostatic test* as uninfluenced by modern discoveries, and that when exceptions to its value do occur they are principally instances where delivery has been aided by instruments, and where death has followed one act of respiration.(*c*)

§ 149. 3d. *Causes of death in the new-born child.*—These causes are usually divided into accidental and criminal, and also into causes of death by commission and by omission. The necessity, however, of constantly keeping in mind the fact, that the imputation of a criminal purpose rests upon the explanation given to the marks by which the various modes of death can be distinguished from one another, induces us to consider them from another point of view, viz., according to the *time* at which they are brought into operation. By this arrangement, the reader will be able to see at a glance that accident and design will often produce the same physical results, and will be enabled to obtain a correct view of the cause in proportion to the closeness of the apposition in which the effects are placed. For the sake of convenience the causes of death in the new-born child may be divided into those which act *before* or *during* birth and those which act *after* birth.

§ 150. (1) *Causes of death before or during birth.*

(*a*) *Compression of, and by, the umbilical cord.*—The umbilical

(*c*) *Vide* an article in the Brit. and For. Med.-Chir. Rev., No. 66, April, 1864, p. 324, from which the views in the text have been drawn.

cord during birth suffers compression unavoidably in breech presentations, and also when it is prolapsed in these and in presentations of the head. In the latter case, if the labor be not brought speedily to an end, or the cord replaced, the obstacle to the circulation of the blood is such, that the child will soon perish. A curious case is referred to by Dr. Elsässer, in which the hand of the child was found grasping the cord firmly and holding it against its face. The child was nearly asphyxiated, and recovered only after a quarter of an hour. There are no distinctive and certain marks proving that death is owing to compression of the cord. Great turgescence and lividity of the features, with a congested state of the head and thoracic viscera, would, in the absence of any marks of violence, afford a fair presumption of it. The converse of this accident happens, when the cord becomes the direct instrument of the child's destruction by being wound around its neck.(*n*) In this case, when death results, it is not brought about exactly in the same manner as in strangulation after birth, the child having then respired; but ensues, either from an interruption in the current in the cord itself, from the tightness with which it is wound around the neck, and the stretch put upon it in the latter stage of labor, or, probably, also, from its constriction of the vessels of the neck, causing congestion, and even extravasation of blood in the brain.(*o*) It does not appear that this accident occurs only when the cord is of unusual length; in fact, in many cases, this circumstance is doubtless that to which the child owes its escape, because it is probably wound around the neck but loosely, and is not rendered tense by the descent of the child. As, however, fatal results occasionally happen from this cause, and as, in unassisted labors, there is greater probability of their occurrence, we cannot dispense with a con-

(*n*) The average frequency of this complication of labor is, according to Elsässer, as one to five. Its danger to the child is variously estimated. According to Mayer, it was the cause of death in only 18 out of 685 cases in which it occurred, while Scanzoni attributes 408 out of 743 cases of stillbirth to this cause. Casper, who furnishes this statement, alludes to a mode in which it may prove fatal besides those given in the text, viz., by causing the child to make inspiratory efforts, and thus draw the liquor amnii into its lungs, after the manner already referred to in § 148.

(*o*) Casper, Gericht. Med. 343 Fall.

sideration of the marks by which it may be distinguished from intentional strangulation before birth. The cases in which intentional strangulation may be effected before birth are those in which the head alone is born, while the body is not yet expelled. Children are not unfrequently strangled while in this position, and it is, therefore, important to know whether this violence has really been inflicted, or whether they may not have perished accidentally by constriction of the neck by the umbilical cord. A case is reported by Ritgen, in which a child, whose head was born and who had breathed, died of apoplexy, from strangulation by the umbilical cord.(n^1)

§ 151. The statement, that marks similar to those of wilful strangulation are often produced in this manner, has, we think, been too readily accepted. Instances have indeed been met with, which support this view, but a very large and careful experience has shown, that the occurrence is far from being a necessary or a common one. Dr. Elsässer,(o^1) in his capacity of superintendent of a large lying-in hospital in Suttgart, instituted a series of observations which have given much greater exactitude to our previous knowledge on this subject.

In the space of seven years, there occurred in that institution 327 cases of labor in which the umbilical cord was twisted around the neck. Of this number, there was one fold of it around the neck in 228 cases, two folds in 82 cases, three in 13, and four in 4 cases. Yet, in the whole series, there was not a single instance in which the least mark, impression, or ecchymosis was visible. In some cases the cord was so tightly wound around both neck and body that it was necessary to divide it before birth could be accomplished. Dr. E. adds, that in a private practice of twenty-four years (1835) he had never met a case in which any mark was left by the cord. These observations establish satisfactorily the great rarity of the occurrence.

§ 152. Yet it would be impossible to maintain that no mark *ever* is left. The author quoted above admits it freely, upon

(n^1) Gemein. deutschen Zeitschrift. Bd. I.

(o^1) Henke's Zeitsch. 1835. Uber Umschlingungen der Nabelschnur um den Hals der Kinder bie der Geburt, in forensischer Hinsicht. Also, Henke's Zeitsch. 31 Erg. H. 1842.

the authority of Carus, Wildberg, Mende, Albert, and other obstetricians. The marks are described as very various in their character; sometimes being merely furrows in the skin, without color, and sometimes red or blue stripes crossing each other and occasionally extending a short distance over the breast or back. Mr. Foster(*p*) reports a case in which the child was born dead, the labor being very tedious. The umbilical cord was twisted around the neck, leaving three parallel colored depressions. Dr. Döring(*q*) examined a new-born child found dead, in which the navel cord was coiled twice around the thigh, passed across the front of the body, and crossing the shoulder-blades, formed a tight loop around the neck. On the left side of the neck, beginning at the ear, there was a purple discoloration of the skin in two directions, viz.: towards the nape of the neck and towards the breast, corresponding to the parts which were pressed upon by the cord. There was no indentation nor ecchymosis, and the death of the child was found, upon examination, to be due to violence. Two cases are given in the same journal by Dr. Albert(*r*) in which the cord left a groove upon the neck, three or four lines wide, and of a dark blue color. The face in both cases was livid and turgid; and in one, in which the child had partially breathed, the eyes and tongue protruded, the latter being blue and swollen.

§ 153. A real ecchymosis, or extravasation of blood under the skin, has probably been observed but seldom in accidental strangulation by the umbilical cord.(*s*) A livid mark does not always indicate an effusion of blood, but is frequently caused by simple congestion—a fact which is proved by its rapid disappearance if the child survives.(*t*) It would not be safe to assume that the existence of ecchymosis disproves the possibility of this accident, because, in addition to the possible occasional occurrence of extravasation, it must be remembered that the marks remaining after intentional strangulation are

(*p*) Med. Gaz. xxx. vi. 485. (*q*) Henke's Zeitsch. Erg. H. 23, p. 29.
(*r*) Ibid. Bd. 42, p. 207. (*s*) Elsässer, loc. cit. 1842, p. 7.
(*t*) Windel, Henke's Zeitsch. Jahrg., 1836, 1 Heft.; Heyfelder, Med. Annal., Heidelberg, 1838, S. 258; Eichorn, Med. Cor. Bl. bayer, Aertze, 1840, Aug. 8.

not always accompanied by it. Even in hanged persons, an extravasation of blood under the mark of the cord is not always found. Nevertheless, if ecchymosis be found under a deep and discolored mark upon the neck, and at the same time there is abrasion of the cuticle or laceration of the skin, such an injury cannot possibly be attributed to the umbilical cord. This opinion is held by Dr. A. S. Taylor,(*u*) and is fully substantiated by a large number of recorded cases. In order that the reader may form an approximate estimate of the proportion of children born dead, in consequence of strangulation by the umbilical cord, we may state that Elsässer reports, that, out of 318 children born with the cord around the neck, three died, or one in 106; Carus found one in 43; and Siebold, one in 61 cases. Two points, however, must not be forgotten in connection with these data, viz., that they were all cases of labor where the best assistance was at hand, and that a certain number of the children were born apparently dead, but revived under the use of proper restoratives. The mortality in concealed and unassisted deliveries would certainly be much greater. Hence a woman, secretly delivered, may be unjustly accused of infanticide whose child has perished from a purely accidental, and by her, irremediable cause. In fact, the cord may be twisted around the child's neck or body during pregnancy, and its death is thus sometimes accomplished before the occurrence of labor.(*v*)

§ 154. The child is not unfrequently wilfully strangled before it is completely born. When a ligature is found upon its neck, there can of course be no longer a question whether the impressions made were due to the umbilical cord. The defence is usually that the ligature was placed upon the neck by the woman herself, with the object of assisting her delivery. No medical evidence can disprove such a statement. If, however, the child has been strangled by the hand, whether wilfully or by accident, in attempts at self-delivery, the impressions left will be of a different character from those produced by

(*u*) Med. Jur., p. 343.

(*v*) Daubert, dissertat. de funiculo umb. fœtu circumvoluto. Götting. 1808. Freyer, de partu diffic. propter funic. umbil. fœtûs collum obstringentem. Halle, 1765.

the constriction by the umbilical cord. A consideration of these will be found under the head of *Strangulation after birth*. We may, however, mention in this place, as the chief characteristic, that the indenture or discoloration made by the umbilical cord surrounds the neck entirely, which is never the case in death from hanging. The mark made by the umbilical cord is moreover broad, the depression is cylindrical, and its edges are soft, and it is not excoriated as when a string or other hard substance has been used. Moreover, this depression is rarely single, as in cases of violence, but oftener double, and occasionally triple, nor is it, as in the other case, hardened at the edges, or accompanied by subcutaneous ecchymosis.(*a*) It may be sometimes important to remember that, in fat children especially, if the neck be short and the body have been kept or found in a cold place, the fat, becoming congealed in the folds of the skin upon the neck, will give rise to furrows, which, to those who may disregard the other signs of strangulation, may suggest the suspicion of a ligature having been used.(*b*)

§ 155. (*b*) *Protracted delivery.*—The child frequently dies solely in consequence of the protraction of the labor, and this is especially the case in first labors, or where the membranes have broken early in the first stage. In such cases, death takes place usually from congestion of the brain, in consequence of the compression it suffers. After such tedious labors, the head becomes apparently elongated, and over the occiput a tumor forms, often called *caput succedaneum*, caused by a congestion of the vessels of the scalp and an exudation of bloody serum into the cellular tissue under it.

§ 156. (*c*) *Debility.*—The child may die, also, from constitutional feebleness, inherited from its parents, or produced by causes acting upon it during its intra-uterine existence. It may survive its birth a few hours or days, and then perish

(*a*) Casper, op. cit., i. 804.

(*b*) The degree of pressure which the cord may exert during fœtal life is illustrated by those cases in which deep impressions and consequent malformations of limbs have resulted from this cause. Even the amputation of a limb has been observed as an effect. Such a case is recorded in Virchow's Archiv, x. 110, by Dr. Frickhœffer, who also cites three analogous instances.

from inherent debility or the neglect of some trifling precaution, which in a healthy child would be of little importance. The inspection of the body will often warrant this judgment when there is no other evidence to show the cause of death.

§ 157. (*d*) *Hemorrhage from the umbilical cord.*—If the body of a new-born child present the evidence, in its blanched and waxy hue, and in the paleness and dryness of the internal organs, particularly of the heart and lungs, of a great loss of blood, the hemorrhage will have proceeded, when no wounds are found which will otherwise account for it, from the umbilical cord. This rule, which is generally admitted, is, however, not applicable when the body of the child is already decomposed; since, during the putrefactive process, according to Casper, the body parts with a considerable portion of its blood. The hemorrhage may have been accidental,(*c*) or permitted with a criminal design. In either case, it may arise from laceration of the cord, or from neglect or omission to tie it. The question of the necessity of tying the umbilical cord, although one which we, in common with the majority of writers, would unhesitatingly decide in the affirmative, is not necessary to be discussed in this place.(*w*) As has been very justly remarked by Dr. Beck,(*x*) the whole question rests upon a simple matter of fact, viz., whether the omission to tie the cord has ever been attended with fatal hemorrhage. "That it has been so, cannot be questioned." Dr. Beck quotes cases in illustration from Foderé and from Dr. Campbell. Many other examples (*y*) might be added to these, but we do not

(*c*) From an imperfectly applied ligature, or from a morbid condition of the child's blood. See a valuable Report by Dr. J. F. Jenkins, Trans. Am. Med. Assoc., xi. 263.

(*w*) It is worthy of remark, that it is the habit of the Indian squaws to *break* the cord, and then bind the fœtal end with a strip of bark. This fact we have on the best authority.

(*x*) Med. Jur., vol. i. p. 511.

(*y*) Haller, Elem. Physiol., tome viii. p. 443. Nägele, Salzb. Med. Zeit. 1819, N. 88, S. 151. Cederschjöld, Med. Chir. Zeit. N. 11, S. 181—seven days after birth. Klose, Henke's Zeitsch. Bd. 40, S. 105. Dolscius, ibid. Erg. H. 34, 1845, S. 180. In this case the fragment of the cord remaining attached to the child was sixteen inches long. The cord had been torn, not cut, by the mother. The child had breathed.

suppose that the least instructed practitioner would neglect this precaution, since, even if hemorrhage should not immediately ensue, there is no guarantee against its occurring at any time within the first two days. Yet Casper, in his long and ample experience, never met with a single instance of the sort, although not less than four cases came under his observation in which the cord was divided close to the navel, and, as he adds, examples of the cutting or laceration of the cord at various distances from the body, and without death by hemorrhage, are of every-day occurrence.(*y*[1])

§ 158. The cord may have been left untied in a *first* labor, through excusable ignorance upon the part of the woman. Such ignorance cannot, however, be plausibly urged in subsequent labors. That a woman, in an unassisted labor, who had neglected placing a ligature upon the cord, should be convicted of infanticide in consequence of the child dying from a neglect of this precaution, is of course hardly supposable.

In many cases, however, of precipitate labor, in positions other than the horizontal one, the cord frequently breaks. Hemorrhage, under these circumstances, would not be surprising. The result of observations on this point is, that in the great majority of cases it does *not* take place. In twenty-six cases given by Dr. Klein, where the cord was torn off close to the navel, no hemorrhage resulted. In Pyl's Aufsätze the account is given of a child which had been placed in a close box, and covered with wool, where it remained six hours, and was taken out perfectly sound and healthy, although its navel string had been torn and no ligature applied. In eleven cases reported by Elsässer, in which the child had fallen from the mother, upon the hard ground or pavement, and the cord was ruptured, no hemorrhage resulted except in two.(*z*) In these, the life of the child was saved by timely help. In two cases, in which the cord was ruptured at the navel, a very small quantity of blood escaped. In two other cases, in which the cord had been cut and no ligature applied to it, no hemorrhage resulted from the omission. One woman is reported to have

(*y*[1]) Gericht. Med., i. 824.
(*z*) Henke, Zeitsch. Erg. H. 31, p. 38.

followed the animal instinct, and divided the cord with her teeth.(*a*) Others broke it in two with the hands. In one case the mother (who had previously borne children) was suddenly delivered in the street, in a squatting position. The child, which weighed seven pounds, fell upon the pavement. The mother immediately broke the cord in two, about four inches from the navel, and, without tying it, put the child in her apron and ran with it to the hospital. There she was delivered of the placenta, with considerable hemorrhage, from which she soon, however, recovered. The child showed no signs of loss of blood. The general opinion, undoubtedly, is correct, that a ruptured or lacerated cord will be much less apt to bleed than one which has been divided by a clean incision.

§ 160. (*c*) *The length of the umbilical cord* is an important element in the consideration of those cases in which it has been broken, from delivery having taken place in a standing position. An example may be cited from Siebold's Journal, vol. xvi. p. 3, where a woman was overtaken by labor and the child born while she was in a standing posture. It fell with its head upon the stone floor and sustained no injury. The cord did not give way: it was twenty-nine inches long. A similar case by Heyfelder is referred to by Elsässer.(*b*)

The usual length of the cord is from eighteen to twenty inches,(*c*) and the average distance of the vulva from the ground, in a woman standing, is, according to fifty accurate measurements made in Dr. E.'s hospital, twenty-six inches, and in a woman in the squatting posture, one-half or two-thirds

(*a*) This is not the practice with all the domestic animals, as is erroneously supposed, but only with the dog, cat, and pig, which, moreover, devour the after-birth. But in the horse and in the ruminant animals, the cord is generally broken by the fall of the young when the mother is in a standing position, or, when delivered in the recumbent posture, by her suddenly springing up. The rupture occurs in general near to the navel. When it is not broken in either of these ways, assistance is usually at hand to make the separation. (*b*) Loc. cit.

(*c*) Dr. Tyler Smith exhibited to the Westminster Medical Society (Jan. 12, 1850), a funis which, measuring from the attachment at the umbilicus to its insertion into the placenta, was *fifty-nine* inches and a half in length. In the Boston Med. and Surg. Journal for July, 1850, one is mentioned which measured *sixty-nine* inches.

of this distance. The distance from the child's navel to the top of its head is from nine to ten inches. Hence, if we add this to the whole length of the umbilical cord, in consequence of the head being the heaviest part of the body, it will be seen that the child can fall from twenty-eight to thirty inches without putting a strain upon the cord. But this distance will necessarily be diminished by the unavoidable separation of the limbs during the descent of the child, it being clearly impossible that a woman can be delivered in a *perfectly* erect position. The cord may, however, be unusually short or wound round the neck, in which case, of course, its rupture will readily take place. The point at which the cord breaks is, in the great majority of cases, near the navel, the distance varying from one to six inches; occasionally, however, it occurs at other points. This circumstance admits of explanation upon the ground that the greatest resistance is at the fœtal end of the cord, the placental portion being more yielding. When the cord does not break, the placenta is sometimes dragged out by the weight of the child. A curious and important case, in which the cord was ruptured while the woman was in the *recumbent* posture, is given by Elsässer.(*d*) The cord was unusually short, and the child forcibly expelled, immediately after the rupture of the membranes. When taken up it cried loudly, and was found to be bleeding freely from the umbilical cord, which was ruptured about three inches from the navel. The cord was from thirteen to fourteen inches long, and not thicker than the little finger, although healthy. The woman had previously given birth to six children.

§ 161. (*f*) *Fractures.*—Where fractures are found on the head of a new-born child, they may be attributed as well to accidental as to criminal causes. If a woman have received in the latter portion of her pregnancy, a violent blow or fall upon the abomen, the child's head may be fractured by the same force. J. P. Frank relates the case of a woman, six months pregnant, who received, on the abdomen, a blow from the but of a musket, in consequence of which she was prematurely

(*d*) Henke, Zeitsch. Erg. H. 31, p. 39.

delivered.(*e*) The child's skull was crushed and the navel-cord broken. Another case(*f*) may be referred to, where a woman near her confinement fell upon an angular stone. The skull of the child was completely crushed, and the woman herself died. Other intra-uterine fractures, it may here be stated, are occasionally met with, besides those of the head. Dr. Keller has given an account of a fracture of the clavicle, which was caused by the fall of the mother from a carriage during the fourth month of pregnancy. At birth, which took place at term, the evident marks of a consolidated fracture, with some deformity were apparent.(*a*) Two other cases of intra-uterine fracture of this bone are related by Mr. John Ewens.(*b*) Basmer relates a case(*c*) in which the right arm and forearm and both thighs and legs of the fœtus, which died immediately after birth, were broken. The earthy matter in the bones formed one-third only of their weight instead of one-half as it should have done. Three cases are quoted by Dr. Gurlt,(*d*) from d'Outrepont, Löwenhardt, and Ozajewski, in one of which the skull of the fœtus was fractured by a shot, in a second by a scythe, and in the third the shoulder-blade was broken by a sickle. In all three cases the children were born dead; in the first two, immediately after the injury, and in the third, at the end of two days. In the first case only did the mother die. In all of these cases the mother was of course wounded. The same author cites eight cases in which falls or blows experienced by the mother produced fractures of the bones of the fœtus. The accident usually occurred in the latter half of pregnancy, and generally the lower limbs were the parts injured. Union of bones so broken is stated to be slower than in extra-uterine life; but on this point the evidence is not very clear. Such cases, however, have little practical bearing upon

(*e*) For another similar case by Callenfels, *vide* Fröbel, Die Nabelschnur in ihrem pathol. Verhalten während der Geburt.

(*f*) Gaz. des Hôp., Nov. 7, 1846.

(*a*) N. Amer. Med.-Chir. Rev., July, 1859, p. 687.

(*b*) Med. Times and Gaz., May, 1860, p. 482; consult also ibid., April, 1860, p. 353.

(*c*) Brit. Med. Journ., 1857.

(*d*) Lehre von den Knochenbrüchen, Frankfurt a. Main, 1860, p. 211.

the subject; the child is born dead in consequence of the injury, and, if not putrid, an inspection of the lungs will at once show that it has not respired. Hence there can be no question of infanticide.

§ 162. Again, however, fracture of the skull may occur *during* labor, in consequence of the relative disproportion of the head to the pelvis, or of a deformity in the latter, arising from osseous projections or tumors. The child may survive these injuries a sufficient time to breathe,(*g*) and, indeed, may recover from them altogether. It becomes necessary, therefore, to take the circumstance into consideration, in all cases of fracture of the skull in new-born children, that it may have occurred *accidentally during labor*.(*h*) Fractures produced in this way are certainly of very rare occurrence, for the child's head often sustains extreme compression, both from the uterus and in forceps deliveries, without being injured. They are found most frequently in the parietal bones, sometimes in the frontal, and never, as far as we know, in the occipital bone. Usually they are mere fissures, unattended with depression and laceration of the integuments. Cases, however, are related by Landsberg,(*i*) and by Danyau, and Ollivier d'Angers,(*j*) in which there was depression. M. Lizé mentions the case of a young woman who was three days in labor, and who was delivered without instruments after great efforts on her part. The child was dead, and the parietal bone of the left side severely fractured.(*j*[1])

§ 163. Although respiration may have taken place, the fact being established by the hydrostatic test or direct evidence, it will not serve as a criterion of the time at which the fracture was produced, since the child may have received it during

(*g*) Klein. (Bemerkungen über die bisher angenommenen Folgen, etc., 1817, § 193.) The child lived forty-six hours. The parietal bones were fractured, and there was extravasation of blood in the brain and spinal canal.

(*h*) For cases *vide* Deventer, Röderer, Baudelocque. E. v. Siebold (his Journal, xi. 3), Schwörer (Beiträge zur Lehre von der Schädelsbrüche, etc.). Begasse (Preuss. Med. Vereinschrift, 1841, No. 37, sec. 181). Mende (Gutachten über einen Zweifelhaften Fall, etc. H. Z. Bd. 3, sec. 277). Casper (Wochenscrift, 1837, 1840, 1851). Osiander, *loc. cit.*

(*i*) Henke, Zeitsch. 1847. (*j*) Ann. d'Hygiène, 32, 121.

(*j*[1]) Lancet, Feb. 1860, p. 180.

the labor, and yet have survived the injury until after it was born and had breathed. In such a case we have nothing left to guide our judgment, but an examination of the extent, situation, and appearance of the fracture. In the majority of cases, in which criminal violence has been used, the fracture is stellated, depressed, and the scalp contused and lacerated. It is plain, however, that slight fractures, productive of fatal results, may be inflicted by violence, and in such cases no reliable distinction can be made between them and those which are caused by compression of the head during labor. The following will serve as an example of fracture without injury to the integuments, but still in all probability caused by criminal violence. An inquest was held in Islington, before Mr. Wakley, on the body of an infant, whose death, there was reason to believe, had been caused through violence wilfully inflicted by the mother. Over each orbital ridge the frontal bone was fractured horizontally, to the length of about an inch. On the right frontal protuberance, the bone had been driven in to the extent of three-quarters of an inch, in the form of an acute wedge-like fracture. The parietal bones were both fractured vertically, to the length of an inch and a quarter, and there were several minor fractures of all the bones forming the superior and lateral portions of the skull. There was, with all these fractures, no trace of injury to the scalp. No evidence was obtained as to the manner in which they were produced. The child had been born alive, and the mother alleged that its death was caused by its having fallen into the pan of the water-closet, where she asserted she was seated at the moment of its birth. The extent of the injuries, and the small distance of the alleged fall, disproved the truth of this statement.(*k*)

The physician should be aware that a *defective ossification* of the bones of the head may be mistaken for a fracture. The distinction is, however, not a difficult one. This condition, when observed, is usually found in the parietal bones, and consists in an absence of one or more of the osseous *spiculæ*, which radiate from the central point of ossification. The gap is

(*k*) Brit. and For. Med. Rev., April, 1854.

filled up by a membrane which unites the bony portions together. The edges of the bone on each side of this membrane are thin and bevelled, sometimes shading off insensibly into it. A fissure, however, which is the result of violence, is indicated, on removing the pericranium, by a red line, the edges of the bone are jagged and bloody, and no membrane intervenes. More or less blood is effused in the neighborhood of the fracture, under the scalp and on the dura mater. If no bone is lost, the edges of the fracture can be adjusted closely together.(*k*[1])

§ 164. Fractures which are occasioned by the *fall of the child* upon the ground, when the mother is delivered in a standing, sitting, or kneeling posture, are deserving of particular attention in a medico-legal point of view. The fractures thus produced present, indeed, no peculiar features by which they may be distinguished from others, caused by direct violence, but the probability of their being due to this accident becomes often a question of extreme delicacy. Landsberg gives a good illustration of this accident in the following case: (*l*) A woman, who had already borne children, was taken in labor, as she ran from her house which was on fire; the child fell from her upon a heap of broken bricks and stones. Fourteen days afterwards there was found, upon the left parietal bone of the child, a swelling of the size of a pigeon's egg, without any discoloration of the skin, and with slight fluctuation. The fragments of bone and crepitation could be easily distinguished by pressure of the finger upon this spot. The child got well.(*m*) Numerous other cases might be quoted; the curious reader will find many

(*k*[1]) The period at which the fontanelles close has been made a subject of inquiry by M. Roger (Union Med., Nov. 1859). They generally close between the second and third year. In three hundred children, the anterior fontanelle was never found closed before the fifteenth month, and never open after the age of three years.

(*l*) Henke, Zeitsch. 1847, 3 Heft.

(*m*) Dr. Swayne reports a case in which a woman, twenty-nine years of age, in her third labor, at full time bore a child in the erect posture. The umbilical cord was torn, and the child, though much bruised, lived to the sixth day, when it died of convulsions. The parietal bone was fractured, and a coagulum was found on the membranes of the brain. Another case is reported by Casper (Ger. Leichenöff). (Assoc. Journ., Oct. 14, 1852, p. 401.)

referred to by Henke.(*n*) Dr. Klein collected one hundred and eighty cases of delivery in the erect posture, in none of which the head of the child was fractured. It is contrary to reason, however, to adduce this as proof (as has been done by some authors) that fractures are not occasioned by the accident in question. The instances which demonstrate its occurrence are perfectly authentic, and if we were reasoning abstractly, it would be far more credible that the fractures should occur under the circumstances referred to, than that they should not.(*n*[1]) The possibility of the accident may therefore always be taken into consideration, in cases of concealed birth, when fractures of the cranium are discovered. Other evidence will be of course required to confirm the supposition.

§ 165. (2) *Causes of death after birth.*—The modes in which a new-born child may meet its death shortly after birth are very numerous. A child may be born with such a degree of *malformation or disease* as to incapacitate it from sustaining life. In all such cases an examination by a competent person will be sufficient to expose the reason of death. It must be remembered, however, that there is hardly any malformation which *necessarily* prevents the child from existing for a brief period, even though it should at last be fatal as a natural

(*n*) Handbuch der Gericht. Med., 12th ed., by Bargmann, 1851.

(*n*[1]) Casper speaks in deservedly severe terms of some writers who, on merely theoretical grounds, deny the reality of this accident. He also mentions the following instances of delivery under circumstances fitted to occasion it. In one a serving woman carrying a heavy burden on her head was seized with labor in the street, and the child was seen to fall from her upon the frozen ground. In the second case, both child and afterbirth were discharged simultaneously in the presence of witnesses. In a third the mother was getting into a high bed, having one foot upon it and one upon the steps leading to it, when the child fell from her. In a fourth, a female prisoner gave birth to a child, which fell upon the floor, while she was dressing and in the erect posture. In a fifth, a married lady in her third pregnancy was thus unexpectedly delivered. Finally, a woman expelled her child while seated in a privy, and the infant fell upon the firmly frozen substances beneath. With such examples before us, concludes Casper, we may safely lay it down as a general law, that sudden delivery while the mother is in an erect posture is altogether possible, and that the child is susceptible of being wounded in the head, and even mortally. (Gericht. Med. i. 811.) For other illustrations, see §§ 175, 176; also, Lond. Times and Gaz. Jan. 1860, p. 98.

consequence. Anencephalous children frequently survive for hours and days, and perform most of the animal functions perfectly well. If violence should be inflicted upon such an unfortunate being, it may be judged according to the ordinary rules; the aim of the physician being only to ascertain what share the injury had in its death. The question of the degree of criminality attached to the destruction of a monstrous child is not, of course, within his province. Minor degrees of malformation are not infrequent, such as extroversion of the bladder, displacement of the viscera, spina bifida, occlusion of the intestine, imperforate rectum, abnormal communications between the cavities of the heart, etc.; many of them are remediable, others are not inconsistent with the attainment of adult life, and none can interfere with the judgment of a medical examiner in any case of infanticide. The same remark will apply to *congenital diseases*. Their actual existence can be ascertained, and allowance made for any influence they may possibly have exerted in causing the child's death.

§ 166. (*a*) *Exposure.*—Under this name may be included all those modes of death which result from the abandonment of the child. The new-born child, unlike the young of many other animals, speedily perishes if uncared for. It requires both warmth and nourishment, and, if deprived of either, cannot maintain its existence. The period of time for which a child may survive, exposed to hunger and cold, is uncertain. Instances are on record, which show a remarkable tenacity of life. A case is related,(*o*) in which a child, in the middle of the night, was thrown out of a window nine feet from the ground. It was still attached to the placenta. It fell upon a pavement which was covered with straw and dung. It remained there, naked and exposed to the night air (in the month of April), for three-quarters of an hour. It was then found, and lived twenty-four hours afterwards. It had received no injury from the fall.

A peasant woman delivered herself of a mature child, in the vicinity of a wood, on the 18th of August, 1842, and, fearing discovery, she concealed it in the hollow of a tree, thrusting

(*o*) Henke's Zeitsch. Erg. Heft. 31.

it, head forwards, into the portion of the cavity which led towards the root, so as to exert considerable compression on the body, doubling it up, as it were. She then laid two stones of three or four pounds' weight upon its buttocks, and concealed the hole in the tree with a larger stone. By a lucky accident, a passer-by, on the 21st, heard its moaning, and withdrew it from its prison, covered all over with fir spiculæ and ants. There were numerous contusions and lacerations upon different parts of the body. Its respiration, at first very rapid, soon became more tranquil, and, although much emaciated, it cried with some vigor, and very readily partook of food. Its temperature was normal. Any change of position called forth screams, due evidently to the pain of the various excoriations of the surface. It continued until the 25th to take nourishment, but the sores on the surface put on an ill character, and it died on the 29th. It seems almost incredible that life should have been prolonged during the exposure of this naked infant, without food, for three days and nights, the temperature of the air varying from 50° to 80° Fahr. Probably its close quarters within the tree protected it in some measure from cold; but the privation of food ought, according to the generally received opinions, to have proved fatal before the period of its discovery. Foderé states that danger to life is imminent after twenty-four hours; and, at most, that the infant can fast from one to two days only.(*p*)

§ 167. Cases of such long survivance are, of course, exceedingly rare. The judgment of the physician must therefore be founded not only upon an examination of the body, but also from concurrent evidence. He must be aware of the length of time the child had been exposed, and the temperature of the locality in which it was found, before he can rely with confidence upon the signs of death from cold. These signs are far from being positive, unless the child has been actually frozen. In this case the skin will be found of a purplish color, the hands and feet swollen, the nails blue, and the face of a bright-red color. The brain is greatly congested,

(*p*) Brit. and For. Med.-Chir. Rev., Jan. 1850, from Henke's Zeitschrift, 1847, 3 H.

and the lungs and right cavities of the heart contain more blood than usual. When the body is brought into a warm place, it putrefies rapidly. The same remarks will apply in cases where death is supposed to have resulted from starvation. It is necessary to know approximately how long the child has been deprived of nutriment, before the absence of food from the stomach, and the general signs of death from this cause, can warrant the opinion that the child has perished for want of food. The signs usually given are, a shrivelled and wasted body, a pale and wrinkled countenance, expressive of suffering, and a dry, tough, and yellowish skin. The mouth, tongue, and fauces are dry, the stomach and intestines empty—the surface of the former inflamed in points, the latter distended with air—the heart flaccid, and the great vessels containing but little blood.(*q*) It is evident that a child may be given unsuitable food, or in insufficient quantities, with a view of destroying its life. Such a fact can hardly come under the cognizance of the physician in a criminal case, except in reference to the general effects of such treatment.

§ 168. (*b*) *Suffocation.*—This word is used here to signify any means by which access of air to the lungs is cut off. It includes, therefore, death by smothering, heavy pressure on the chest, strangling, and drowning, as well as the purely accidental modes of death immediately after delivery. The general signs of suffocation are the same in these various cases; but if wounds have been inflicted upon the child, causing hemorrhage, or if it has lost blood from the navel cord, the signs alluded to will mostly disappear. They consist in congestion of the brain, but particularly of the lungs and right side of the heart, which are filled with dark blood.

Besides these appearances, which are common to asphyxia n the adult and in the child, there are in the latter, often observed, numberless sanguineous extravasations very much like petechiæ, in the pia mater, upon the pleura, surface of the heart, and the aorta. These have been carefully described by Casper and by Mr. Canton, of London, as occurring in children which have been overlain, or which have been intentionally

(*q*) Bock, p. 257.

suffocated. All the cases upon which these observations were founded were subjects of judicial inquiry.

The *accidental* causes of suffocation are present after delivery. Frequently the woman, being either unconscious or unable to help herself, neglects to remove the child from the pool often made by the discharges in the bed. Lying in this, with its mouth downward, the child will perish from want of attention. Again, the membranes may interpose between its mouth and the air, or its mouth be so filled with viscid mucus, that, unless some little help is given it, it may easily be suffocated. Children are often designedly or accidentally smothered under the bedclothes, in boxes, etc.

The following is a curious example of accidental suffocation of an infant. Mr. Llewellyn, surgeon, found the child dead; the tongue protruded, the face was very livid, and it had all the appearance of having been suffocated. He questioned the mother, and she told him she had dreamt that a mad bull was attacking her, and had squeezed up the child to protect it, and, when she awoke, as she found the child cold, she called her husband. The child had been properly taken care of. The parents had three other children, were very industrious people, and kind to their children. The child was lying on her arm, and its death might very probably have occurred as she described it.(*r*)

If much pressure have been made upon them, the body and head will be found flattened, the eyes and lips remain half open, blood flows from the nose, the tongue protrudes, frothy mucus is present at the corners of the mouth, and the excrements have been voided. The limbs are generally extended, the skin is not uniform in color, and presents here and there violet ecchymoses, the lips look blackish, and the nails livid.

§ 169. Sometimes the child is suffocated by stopping its mouth with foreign substances. Hence the necessity, in every case presenting signs of suffocation, of closely examining the mouth and fauces, although, indeed, instances are not wanting where all traces have been carefully removed previously. A very interesting case is reported, in which the child was im-

(*r*) Brit. and For. Med.-Chir. Rev., Jan. 1855, p. 292.

mersed living in a pot of ashes. The woman's confession confirmed the result of the medical examination, which showed that the child had been gradually asphyxiated. The ashes were found in the nostrils, mouth, fauces, and pharynx. There were none in the windpipe.(*s*) A case is reported by Dr. Littlejohn, in which the child was suffocated by dough forced into its pharynx and larynx; and another is quoted by the same writer, in which a plug of newspaper had been used to produce suffocation.(*s*[1]) Another case,(*t*) instructive in this connection, is also of interest from the uncertainty whether or not the child was living when the outrage was inflicted upon it. A child was found, in which the fauces, the upper portion of the œsophagus, the larynx, and the trachea, were tightly packed with a coarse greenish-black sand. At the same time the child's lungs evinced no sign of respiration, and sank to the bottom of the water when subjected to the hydrostatic test. While it is difficult to imagine for what purpose, if the child were already dead, the substance found so tightly wedged into the entrance of the respiratory passages and throat could have been forced there, it is no less strange that such an act of violence could have been perpetrated upon a living child, without its lungs showing signs of, at least, imperfect respiration. The case unfortunately remains without solution; but, in whichever light it may be viewed—whether as an unaccountable act of violence after death, or an unique case of successful prevention of *respiration*—it cannot fail of being of great interest to the medical jurist. A child may also be destroyed by being exposed to noxious vapors, as those of burning charcoal or sulphur, the exhalations of privies, etc., and no trace will remain of the cause of its death, except, in some cases, the odor of the deleterious gas or vapor which destroyed its life. Cases bearing upon this point will be found in § 130.

§ 170. (*c*) *Strangling.*—The marks of strangulation differ according to the means by which the violence is effected. As a general rule, more violence being used than is necessary to

(*s*) Ann. d'Hygiène, 47, p. 460, 1852.
(*s*[1]) Edinb. Med. Journal, i. 521.
(*t*) Casper's Vierteljahrschrift, 1852, II. 2.

accomplish the purpose, distinct marks of a cord or of the fingers, with abrasion of the skin, will be met with. These marks will be irregular in shape and size, being either spots, furrows, or indentations, red or livid in color, with sometimes subcutaneous extravasation. In the absence of these signs, we may be at a loss to explain the manner in which suffocation was accomplished. But, even if the marks spoken of exist, it may be alleged that they were produced accidentally by the umbilical cord, as we have before explained (§ 153), or, as some authors affirm, by the efforts of the woman to assist herself in her delivery. Such an idle assumption will frustrate the best medical evidence, if received, since the physician can only determine whether the marks are those of strangulation or not; he can seldom decide with certainty how they were made, and much less whether before or after complete birth and respiration. It is sometimes necessary to know whether the marks of strangulation could not have been produced *after death.* This, upon good authority,(*u*) may be answered in the affirmative, if the body be still warm when the constricting force is applied. The question as to whether the umbilical cord had been severed before the strangling was attempted, is of no importance in a medical point of view, since this circumstance will not in any manner affect the signs of the mode of death, and respiration may have been perfectly well established long before the cord is cut.

A case is related in the *Lancet*,(*v*) where a child, with the placenta attached to it, was buried in the ground, and covered one inch and a half deep with earth. It was found that at least half an hour had elapsed since the earth had covered the child, and yet, when it was taken up, respiration was still going on.

§ 171. Maschka relates a case(v^1) where a child was found in a privy. The heart and lungs floated, apparently from decomposition, for after pricking the bullæ and compressing the lungs they sank, yet fæces and sand pervaded the smaller bron-

(*u*) Casper's Wochenschrift, 1837; Ollivier (d'Angers) Ann. d'Hyg., vol. xxix. p. 149.

(*v*) Am. edit., 1850, p. 513.

(v^1) Viertel. f. Ger. Med., 1865, N. F. Band II. p. 87.

chial tubules. The decision given by Maschka was that the child had been dropped into the privy alive, and had there attempted to breathe. The mother stated that it was expelled from her while she was at stool.

§ 172. (*d*) *Drowning.*—The signs of death by drowning, in the new-born child, do not differ from those found in the adult, and are elsewhere fully considered. Generally, however, children which are found dead in the water have been thrown into it, for the purpose of concealing the body, after they have already perished by natural or criminal means. Hence it is not often that the peculiar signs of death by drowning will be met with, but, in all cases where children are found dead in the water, search should be made for traces of other violent injury, and it should be especially noted whether respiration has occurred. If marks of violence are found upon the body, particularly fractures, they must be carefully examined for the purpose of ascertaining, if possible, whether they could have been accidentally produced by substances in the water, or whether they were not rather due to criminal violence, and inflicted during life. Such a question will very naturally arise, when, for instance, a large stone is found in the bag in which the child has been thrown into the water. A case of this kind has been reported in Henke's Zeitschrift. The general rules elsewhere detailed, by which a distinction may be made between wounds inflicted before or after death, are applicable here. These signs will not be affected by the submersion unless putrefaction has taken place.

§ 173. (*e*) *Wounds.*—The general distinctions between wounds inflicted before and after death are considered in the chapter on WOUNDS, Book V., Part II. The remarks there made are equally applicable in the case of new-born children.(*v*[2])

(*v*[2]) Wounds found upon a child may have been inflicted in utero, just as the fractures are which have already been referred to. Mr. Lynch (Brit. Med. Journ. and Abeille Méd., xv. 95) reports the case of a child born dead at the eighth month with a contused wound of the back, looking as if the skin and muscles had been violently torn from the occiput to the sacrum, and also as if the part had begun to heal. A week before the mother had met with a fall upon a piece of wood. In another case, reported by Dr. Finnell, there existed a penetrating wound of the leg which he attributed to a stab in

Wounds inflicted upon them being very rapidly fatal, the signs which show that they were made during life, drawn from the ensuing inflammation, rarely come under notice. The character of the blood effused is, however, a diagnostic sign of great value. If this is found coagulated, there can be little doubt that the child was living when it received the injury; but if, on the contrary, blood be found extravasated under the wound, or effused around it, and still remaining liquid, we may be equally sure that the wound was made shortly after death, and while the body was still warm. A recent observation by Ollivier d'Angers will illustrate this fact. In this case the child was murdered before it had breathed, but while the circulation was still going on, as was proved by the examination of numerous wounds made by a cutting instrument in the back of the throat, as well as of other injuries. Coagula were found upon the orifices of the wounds. An incised wound may be accidentally inflicted upon a child by the knife or scissors, in severing the umbilical cord. When this happens, it will generally be found that the fingers or toes, or some part of the limbs, which have been suddenly elevated by the child at the moment of the incision, are injured. Where there is any suspicion of the wound having been produced in this way, the physician must carefully examine the situation, extent, and shape of it, and assure himself that the cord has really been cut, before assenting to the probability of this explanation. A peculiar mode by which the new-born child is often destroyed, is the introduction of pointed instruments, such as pins or knitting-needles, into the fontanelles, the ears, the nose, and between the vertebræ. In a superficial examination, these injuries may be overlooked. Hence, in doubtful cases, attention should be carefully given to this point. By dissecting out the suspected portion of skin, and stretching it against

the abdomen below the umbilicus, received by the mother a week before her confinement, which was brought on by her injury. Immediately after the infliction of the wound, a gush of water followed by blood had taken place from the uterus. (New York Journ. of Med., Jan. 1860, p. 99.) A very remarkable case of fœtal wound is published in Med.-Chir. Trans. xxxii. 59, and several others of extreme interest are referred to by Dr. Montgomery, Signs and Symptoms of Pregnancy, 2d ed. p. 684.

the light, the finest puncture can be detected. Sometimes a multiplicity of wounds is inflicted. The following cases will serve as examples. A young woman, becoming pregnant, concealed her situation with great care. Her parents could not prevail upon her to acknowledge it, but it was finally ascertained by a midwife. She was confined alone. She seized a pocket-knife, thrust the blade into the child's head, back, abdomen, and limbs, cut off its head, and concealed the bleeding fragments under her paillasse. She was soon discovered, and at first denied the crime. Afterwards she brought the knife to the mayor, and made no attempt to escape, but confessed the act, and ascribed it to despair at having been abandoned by her lover.(*w*)

A still more inhuman example of infanticide is reported by Prof. Toulmouche.(*x*) It was proved that Severine L—— had borne an illegitimate child, of which no traces could be found. The girl, who at first obstinately denied the charge, finally confessed the crime, and indicated to the medical officers the place where she had concealed its remains. She said that she had been delivered at night, had suffocated her child, then cut it into pieces, the better to conceal it in the chamber vessel, which she than carried into the garden, and threw the contents into a dung-heap. With some difficulty the fragments were nearly all recovered, and placed in apposition. The head, thorax, and abdomen had been all separated from each other by a cutting instrument. The head was dreadfully mangled, the arms were cut off from the chest, and the forearms from them again, and many of the fingers also were separated. In like manner, the lower extremities were dissevered. The genital organs were separated completely. The lungs were of a rosy color, crepitant, and weighed two and a half ounces, with the heart and thymus attached. Being put into water, they floated, even after being subjected to enormous pressure. A portion, after being placed under a weight of 60 kilogrammes (132 lbs.), still swam. The heart and the blood-vessels were entirely empty of blood, and the substance of the former was very pale. From these, and the signs which indi-

(*w*) Ann. d'Hyg., 1851. (*x*) Ann. d'Hyg., July, 1853.

cated the maturity of the child, it was justly concluded that it was at term, had lived and breathed, and that its death was caused by the wounds inflicted upon it by a cutting instrument. Siebold(*y*) also witnessed a case somewhat like the foregoing, in which the mother, actuated by the usual motive, viz., fear of abandonment, destroyed her new-born child by cutting off its head. In this case, also, the hydrostatic test clearly proved that the child had fully breathed.

§ 174. (*f*) *Dislocation.*—There have been examples of infanticide by dislocation of the neck. The discovery of the luxation requires no unusual skill in post-mortem examinations.(*z*) As the existence of other dislocations in children found dead may give rise to a suspicion of criminal violence, it should be known that intra-uterine dislocations are occasionally met with. Dr. J. B. S. Jackson has described a complete upward dislocation of the head of the thigh-bone, and a partial dislocation of the knee-joint, in an acephalous fœtus weighing two pounds and two ounces.(*z*[1])

§ 175. (*g*) *Unconscious delivery.*—It is frequently alleged, in defence of women charged with infanticide, that the rapidity of their labor, and the sensations attending it, were such, that they were not sufficiently conscious, at the moment of the expulsion of the child, to save it from danger. This defence is often made in those cases where the dead body of the child is found in a privy-well, or water-closet. Although, in many cases, the proof of delivery having taken place in the manner described, depends upon other evidence than that required of the physician, yet there are questions which he will be called upon to answer, relative to the probability of the occurrence, which will demand very careful reflection. At first sight, the fact may appear highly improbable, that a woman should possibly mistake the convulsive pains of labor for the ordinary sensation of a call to stool, or that any labor, however easy or rapid, could be accomplished without her being fully conscious of it. With due allowance for cases of wilful deception and

(*y*) Henke's Zeitsch., 1845, p. 157.

(*z*) For a case in point see Orfila, Med. Leg., vol. ii. p. 109.

(*z*[1]) Boston Med. and Surg. Journ., March, 1860, p. 127.

of purposed wrong to the child, there remains sufficient evidence to show the possibility of unconscious delivery in this sense. As the child's head descends into the pelvis, the mother is often seized with an irrepressible desire to evacuate the bowels, and nothing is more common than for this evacuation to take place, in spite of all efforts to restrain it, at the very moment that the child is expelled. Hence, it is quite intelligible, that a woman in labor, in the absence of proper advice, may seat herself upon the privy hole, or night-stool, at precisely the most critical moment for the child. By a forcible pain, favored by a very yielding condition of the parts, the head may be abruptly expelled; the cord may break with the fall of the child, which may perish miserably, either by the injury received in its fall, or stifled with the filth into which it is plunged. The mother, exhausted and terrified, may be unable to prevent this catastrophe. Cases of this kind are related, of married women and of others, where there was no attempt to conceal the birth, and no suspicion of criminal intentions.(*a*) An English lady in India was pregnant at full term with her second child. She experienced a very slight sensation as if her bowels were about to be relieved; a feeling as if something had touched her body followed, and caused her to ask the attendant to lift the bedclothes, when, to the surprise and alarm of both, the child was found entirely extruded. It was but slightly undersized.(*a*[1]) An equally striking case, in which the escape of the child from the maternal parts was mistaken for an evacuation of the bowels, is reported by Ammeuille.(*b*) While a want of knowledge of the phenomena of labor may plausibly account for the event in a woman with her first child, yet the greater rigidity of the parts, and the slower progress of the delivery in this case, render its occurrence far more unlikely than in those who have already borne children. It

(*a*) For cases illustrative of this fact, *vide* Henke's Abhandlungen, Bd. I. S. 40 ff. 2te Aufl.; Dr. Schnitzer (Med. Zietung d. ver. f. Heilk. in Preussen, 1839); Fleischmann (Henke's Zeitsch. 1839, 2 H.); Dr. Beck (Ed. Med. Jur., p. 317, note); Ricker (Henke's Zeitsch. 1843, 3 H. p. 197). Also note to § 164.

(*a*[1]) Dr. G. Smith, Brit. and For. Med.-Chir. Rev., Oct. 1857, p. 554.

(*b*) L'Union Méd.; and Phila. Med. and Surg. Reporter, March, 1860, p. 501.

is said, that, if the cord be found broken, instead of cut, it will confirm the story; but this circumstance is not conclusive, since it may have been broken by the hands of the mother, and the child afterwards thrown into the privy for concealment. In most cases, our opinion can be founded only upon the traces of blood at and near the alleged scene of labor, and upon the absence of conflicting testimony. The concealment of the fact of having given birth to a child will throw just doubt upon the woman's veracity, since, if the delivery were accidental, the natural presumption is, that the mother would have sought for immediate assistance.

Other forms of unconscious delivery do not possess the same practical interest as the foregoing. Women may be delivered in a state of insensibility, and, according to Dr. Montgomery, even during deep natural sleep: in such cases, the child may perish from want of attention, and in some one of the various ways before alluded to.(*b*[1])

Delivery may also be so *rapid*, although the mother is aware of being in labor, that she is unable to guard against an accident to the child. Mrs. B., of Quebec, aged thirty, married, and pregnant with her first child, was seized during the night with labor-pains. After bearing them for a long while, she requested a woman to give her some warm water to "set over," to relieve what she described as a great pressure at the lower part of her bowels. She had hardly seated herself upon the edge of a rather high chair, when a severe bearing-down pain seized her, and before any assistance could be afforded (although one or two women were in the room), the child was forcibly expelled, and fell, head foremost, on the floor, being killed on the spot. When the physician arrived, about twenty minutes after delivery, the child, although dead, was still attached by the cord to the placenta, which came away shortly after the infant. In another instance, the wife of a clergyman, in labor with her *second child*, but not suffering from any pain, was suddenly seized with a strong bearing-down pain, and got up with the intention of walking into an adjoining room. Before she had proceeded more than a few yards, another pain threw

(*b*[1]) See Rawson, Lancet, 1841; Schultze Ann. d'Hyg., v. 33, p. 216.

the infant upon the carpet. The cord was ruptured near the umbilicus, but fortunately *did not bleed* from the fœtal portion. The child was not injured. A similar case is related by Dr. Larkin, of Wrentham, Mass., except that the cord was so long, that it was not broken. The mother broke it in two, and succeeded in reaching her bed-room, although much exhausted from hemorrhage. Both mother and child recovered.(*c*)

§ 176. (*h*) *Poisoning.*—This form of infanticide is extremely rare. Dr. Taylor states, that the earliest stage at which he has known a trial to take place for the murder of a child by poison, was *two months.* In this case, a quantity of arsenic was given to the child, and it died in three hours and a quarter after its administration.(*d*)

More recently, a woman destroyed her child, which was only *one day* old, by arsenic. She was tried, and acquitted upon the plea of *puerperal insanity*, although the evidence certainly did not warrant such a verdict. Mr. Justice Creswell, at the close of his charge to the jury, "read the whole of the evidence, and at the close remarked that he was bound to tell them that there was undoubtedly no direct proof that the prisoner was otherwise than in her perfect senses, as no person saw her laboring under delusion or insanity."(*e*)

The defence in this case should suggest to the medical expert the reflection, that, however palpable the fact of criminal agency may, in a case of infanticide, appear to him, and however complete may be the proof of the child having both lived and breathed, he can never be exempt from the mortification of hearing objections urged, entirely foreign to the case, and a defence set up which has merely an imaginary basis.

Luschka(*f*) draws attention to the fact that on the lips of new-born children there is an outer smooth zone and an inner villous one with a marked furrow between, looking when the mouth is gently closed like a double lip. The villous zone disappears with advancing age; but, should death occur before

(*c*) Am. Journ. Med. Sci., Jan. 1846, quoted from various sources.
(*d*) R. *v.* South, Norf. Aut. Circ., 1834.
(*e*) Ed. Monthly Journ., Sept. 1852.
(*f*) Henle, Zeitschrft. f. Nat. Med., xviii. p. 88.

it has done so, it dries even down to the submucous tissue, and looks much like an eschar, which, unless understood, might readily be taken for the effect of a corrosive poison.

§ 177. Some valuable experiments and conclusions by Casper, contained in his *Vierteljahrschrift*, 1863, Heft I. p. 1, are here added as being perhaps the most appropriate place. From the fact that one-fourth of all the medico-legal inspections annually ordered in Berlin are upon the persons of new-born children, Casper was led to believe that the attempts made to conceal the bodies often occasioned such injuries as caused a legal investigation to be instituted. As a contribution to the elucidation of this point, twenty-five experiments were made upon the bodies of newly-born children. From a height of thirty inches, ten infants were dropped upon an asphaltum and fifteen upon a stone pavement. There were no visible injuries to the surface produced, but in twenty-four cases fractures of the skull were found. The fractures were distributed as follows: one parietal, sixteen times; both parietals, six times; once the parietal and frontal of the same side; once the frontals of both sides; and once the occipital had sustained a fracture. Numerous fractures were not found. The peculiar form of injury is also worthy of notice. Almost always one, two, or three fissures extended from the parietal protuberance to the margin of the bone, and sometimes extending across the sagittal suture to the parietal of the opposite side; twice a small portion of bone was broken off. Twice, when the body was allowed to fall from the table, fracture of the parietal resulted. When the head was trodden upon by a heel, fractures were always produced, not only in the parietal touched, but in the opposite bone, which looked much as if done in life. Extensive injuries were produced by striking the head against a table or wall. Four bodies were placed two or three inches under ground which was then stamped level; in three of the cases fractures resulted. No result was obtained by compressing the head with the hands, or by falling suddenly upon the child placed upon a hard surface. Compressing the head into a narrow box was attended with no result in two cases, but in a third a slight cleft extended from the lambdoidal suture

into the left parietal bone, while the coronal suture was somewhat separated. Extensive injuries were easily produced by blows with a mallet or hammer. In all the cases the fractures were like cracks in glass. In five only, out of sixty fractures, were serrations present. Detachment of dura mater, separation of sutures, extravasations of blood beneath the pericranium, and coagulations at the seat of fracture are not peculiar to the living. More or less coagulated extravasations were pretty constantly found, and the other appearances mentioned were not infrequent. In conclusion, we are warned that the fœtal skull, like that of the adult, may be more resistant after death than it is during life. The cases are perhaps too few to establish laws, but coming as they do from so high an authority, are worthy of the most careful consideration.

§ 178. 4th. *General considerations.*—The reader will not fail to perceive, that in the considerations upon infanticide now presented, the author has not taken up all the objections which are usually urged against the various points in the medical evidence; to have done so, would not merely have unduly lengthened the chapter, but have presented the subject under an aspect of obscurity and difficulty which it really does not in itself possess. It has appeared to him that the simplest and most perspicuous mode of presenting the subject was one in which it should be entirely divested of the trivial and irrelevant objections which are often thrown around it, and which are by no means essential for a correct understanding of it.

§ 179. The discussion on this subject may be appropriately concluded by some general considerations. In every case of suspected infanticide the following questions, says Böcker, arise:—

1. Did the death occur in a natural manner?
2. Could it have been prevented by proper precautions?
3. Is the mother guilty of not having employed them?
4. Was it caused by violence on the part of the mother?
5. If traces of violence exist upon the child, did the mother inflict them?

It must be admitted, however, that medical testimony alone is not competent in all cases to solve these questions, which

can only be answered by a careful comparison of all the circumstances of each case.

§ 180. It is a fundamental principle laid down by Henke that death by violence is by no means to be inferred from the fact that the child was born alive. Even where marks of death by violence exist, it does not follow that the child was murdered. In the former case it may have perished in consequence of some disease incompatible with its life, or have been suffocated by the caul upon its face, or by its lying in a pool of blood and water, or in a mass of feces, or under a limb of the mother while in a state of exhaustion or unconsciousness; or, in consequence of there being no help at hand, or of the unwillingness of the mother to betray her condition, the child may be suffocated, or may perish from exposure to cold, etc. While, says Casper, we refuse to be imposed upon by the "impudent lies" which women do not hesitate to tell to conceal their guilt, we should not forget that the dangers to new-born children are very numerous, and that, without any criminal intent upon the mother's part, the child may perish from any of the causes just mentioned, from an injury to the head, from constriction of the navel-cord or hemorrhage following its rupture, from falling into the privy or a close stool, etc. Even apparent marks of violence must be cautiously interpreted. Prints of finger-nails upon the head and face of the child may have been made by the efforts of the mother to extract the child after the birth of its head, and even a dislocation of the neck, under the circumstances, must be regarded as within the limits of possibility. But if the marks referred to should be accompanied by others which can only be explained by intentional violence, then the former must be more seriously interpreted. Yet it must not be forgotten that many marks of accidental injury are with difficulty to be distinguished from such as are feloniously inflicted. Care should also be taken not to confound these with marks which may have been made after death in recovering the body from cesspools, privies, and similar places, or which are merely signs of the voracity of fishes, hogs, rats, etc. In fine, the duty of the medical jurist, called upon to investigate cases like those

which the investigation brings to light.

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CHAPTER I.

DOUBTFUL SEX.

§ 181. THE word *hermaphroditism*, which at one time was used to describe the union of the organs of both sexes in one individual, is now generally applied to all those cases in which doubts exist concerning the real sex, in consequence of some aberration from the normal type of the genital organs. The word can no longer be used in its original acceptation, for most certainly there is no authentic case of self-impregnation recorded, nor even of the association of the generative functions of both sexes in one person. The cause of these deviations from the usual form may be found in the earlier stages of embryonic development; but an exposition of the present state of medical knowledge relative to the processes of faulty evolution would here be out of place.

§ 182. The practical question which we have to determine is, how far is it possible to discriminate the true sex of a living person? The solution of it is attended with no little difficulty, and in some cases is indeed impossible. The physician will be chiefly embarrassed in the case of children, since the important indications derivable from the general as well as local sexual development will be wanting. It should not be forgotten that even after death a positive opinion is, in some cases of hermaphroditism, hardly warranted by the most care-

ful anatomical inspection. The male and female sexual organs, imperfect in development although distinctive in character, may be so evenly distributed that it will not be possible to know which predominate. Or, on the other hand, the traces of sexual organs may be so indistinct, that we can give them no appropriate sexual name. Hence the reader will perceive how much more excusable is reserve in pronouncing an opinion upon the sex of a *living* person, the essential generative organs being concealed from our observation. We can only hope to approximate to the truth, by observing whether there is not some regularity in the freaks of nature, and thus discover, if possible, some uniform correspondence between the visible deviations and those which are hidden from our view. With this object, the cases of hermaphroditism may be divided into the *apparent* and *real*, besides which there is a certain number in which literally *no* sexual organs exist. In the cases of *apparent* or *false* hermaphroditism, either male or female character predominates, but the former much more frequently.

§ 183. 1st. *Male hermaphrodites.*—In these the only anomaly is external, the internal organs having their natural conformation and development. The penis exists, more or less developed, with an urethra either normal or opening at variable distances between the glans and the pubis—a condition which is called *hypospadias.* The scrotum is divided or cleft, and thus presents a resemblance to the vulva, but neither nymphæ nor vagina are found, although not unfrequently there is a shallow depression or cul-de-sac between these false labia, which is lined with a delicate skin and bears no very distant resemblance to the vaginal entrance. The testes are found on each side of the divided scrotum. The history of a supposed female named Marie Rosine Göttliche is related, who had been in the practice of cohabitation with the male sex. Her genital organs were formed in the manner here described.(*a*) Nägele gives a case of twins who were considered as female until their seventeenth year. At this time it was discovered that they were male, the penis being imperforate, and the divided scrotum re-

(*a*) Casper's Wochenschrift, 1833, No. 3.

sembling a vulva, but containing a testis on each side.(*b*) The case of Adelaide Préville, who lived in the married state for a long time and on good terms with her husband, is related in full by St. Hilaire, with a number of other cases which will also fall under the above general description.(*c*) Persons with these malformations are not necessarily impotent, except where the urethra opens at or near the base of the penis. In consequence of the position of this orifice, the semen cannot be ejaculated into the vagina, but escapes along the sides of the cleft in the scrotum. Impregnation may, however, take place, if the urethra opens far enough forward to allow of the inclusion of its orifice within the vagina, and instances of impregnation by persons affected with a considerable degree of hypospadias are upon record. Sometimes the only deficiency observable in this class is the absence of the testes from their usual location. This condition is liable to be mistaken for another, but far more important deviation from the natural type in the internal organs of generation (mentioned further on), since in both, the scrotum is empty. But, in this case, the testes are not really deficient, but have remained in the abdomen, instead of descending as is usual in the ninth month of fœtal existence. In the case of persons in this condition, the power of procreation is unaffected, provided the testes are healthy.(*c*[1]) This anatomical defect is very rare. Siebold states that of 37,000 recruits in Würtemberg, only twenty-four were found in whom the testes had not descended.(*d*)

§ 184. 2d. *Female hermaphrodites.*—By far the greater number of these owe the doubts concerning their sex to an unusual size of the clitoris. Commonly associated with this circumstance, are an unfeminine appearance, more or less beard, and a rough and masculine voice and manner: although the sexual desires of these persons are violent, they are usually barren. The usual length of the clitoris in the adult female is about half an inch, but Remer mentions having seen a clitoris an inch long in a girl seven years of age, and Home,(*e*) one of

(*b*) Siebold's Handbuch, p. 95.
(*c*[1]) See § 201.
(*e*) Philos. Trans., 1799, p. 163.
(*c*) Hist. des Anomalies, t. ii. p. 53.
(*d*) Handbuch, p. 82.

two inches long and as thick as the thumb, in a negress twenty-years years old. In addition to this hypertrophied condition of the clitoris, an imperfect urethra with one or more openings is often found, and, at the same time, a constriction of the vagina to such a degree that it becomes almost imperforate. Such was the anatomical condition in *Marie Lefort;* she had menstruated regularly from the age of eight years until her death at thirty; the existence of a uterus was clearly established. Her voice was masculine, and she had a thick and strong beard.(*f*) Sir Astley Cooper examined the body of a charwoman, aged eighty-six years, who presented these deviations. He says, she differed from other women in the magnitude and length of the clitoris, in the absence of the external orifice of the vagina, which began in the urethra itself, and in the imperfect development of the ovaries.(*g*) A woman twenty-five years of age, on account of her notorious commerce with both sexes, was placed under strict police supervision. Resorting to masturbation, her health became so much impaired that she died in the course of sixteen months. The external genitals were found to have their natural conformation, with the exception of the clitoris, which was three and a half inches long and three inches in circumference, and imperforate, except at the base. The uterus and one ovary were rudimentary, and the general conformation of the breasts was masculine, although, owing to the occurrence of a trifling periodical discharge, she was considered to be a woman. It was proved that this person had been guilty of the most astonishing and unnatural excesses with young people of both sexes.(*h*) A child described by Mr. E. Smith may be placed in the same class, as all the female organs were complete; the only anomaly being that the urethra opened in two places, and the clitoris bore some resemblance to the penis.(*i*) In a black female subject, dissected by Dr. Jno. Neill, the clitoris was five inches long and one inch in diameter, and resembled a penis, except

(*f*) St. Hiliare, Hist. des Anomalies, t. ii. p. 74.

(*g*) History of a supposed Hermaphrodite, by Robert Merry, Surgeon. Guy's Hosp. Rep., Oct. 1840.

(*h*) Henke's Zeitschrift, Bd. 44, S. 183, by Albert, of Euerdorf.

(*i*) Lond. Med. Gaz., vol. xxxiii.

that it was not traversed by a perfect urethra. The perineal opening was not larger in diameter than a catheter of average size, and the vagina was extremely narrow. On one side of the penis existed what appeared to be a scrotum, but which contained an irreducible omental hernia. This gave the feel of a testicle, but no true glandular structure or excretory tube could be detected. The internal organs were completely female, although not completely developed. The general habitus was feminine.(*j*) A very similar case is reported by Dr. F. L. Parker.(*k*) The subject of it was of the negro race, was regarded as a man, bred as a cooper, and had been married as a man. The genital organs were exclusively those of a female, except the clitoris, which measured, after death, an inch and three-quarters externally, and in its entire length five inches. A perfectly analogous example in which the clitoris was from two to three inches in length, is reported by Dr. J. Mason Warren. The subject was of Irish birth, bore a man's name, and had a masculine appearance.(*a*) Dr. Bainbridge has reported the case of a female whose clitoris was five inches in length and of the diameter of the quiescent penis of an adult. This malformation was discovered while the woman was in labor.(*b*) Mr. Wells has described the case of the person in whom the general external organs were those of a hypospadic male; but there were no testes, and a small uterus and one ovary existed.(*c*) The case related by Dr. Mayer, of Bonn, which gave rise to much discussion, and which is usually classed among the cases of mixed sex, may with more reason, we think, be placed under this head. The only male organs were a (so called) penis, which was only two inches long, imperforate, and partly concealed under the *mons veneris*. On the other hand, the orifice of the urethra was situated as in the female, there was a large vagina, a uterus with its appendages, and a defective ovarium on one side, and (what is called)

(*j*) Quarterly Summary of Trans. Coll. Phys. Philada., N. S., vol. i. No. 3.
(*k*) Charleston Med. Journ., Jan. 1859, p. 57.
(*a*) Am. Journ. Med. Sci., Jan. 1860, p. 123.
(*b*) Lond. Times and Gaz., Jan. 1860, p. 45.
(*c*) Ibid., Feb. 1860, p. 177.

a withered testis on the other. We cannot avoid holding some doubts concerning this last-mentioned organ. From the absence of any account of the seminal tubes, deferent vessels, or seminal vesicles, and the evidently rudimentary nature of this body, it might as properly have been termed an ovary. This supposition would, moreover, have been favored by its position. However this may be, it is evident that the female character greatly predominated. When twenty years of age, this person menstruated on three different occasions. A certain number of cases are recorded in which a prolapsed uterus or an extroverted bladder has grossly imitated the male organ, but these cases are so easy of detection, and have so little claim to be classified with permanent anomalies of evolution in the sexual organs, that it is not necessary to dwell upon them.(*d*)

§ 185. 3d. *Real hermaphrodites.*—Not a few authors have doubted the existence of persons entitled to this designation, but there can, at the present day, be no question of the fact. It is, of course, not meant that the union of the *functions* of both sexes in one individual ever occurs, but merely that the essential generative organs of both may coexist.(*d*[1]) It will be seen from the following cases that this abnormal condition is found in different degrees.(*e*) The first we will mention is the case observed by Petit, and communicated to the French Academy in 1820. The subject was a soldier who died of a wound at the age of twenty-two years. The penis was normal, the scrotum empty, the testes small and soft, occupying the position of the ovaries, but provided with epididymis and vasa deferentia. The seminal vesicles and prostate gland likewise were present. The uterus opened into the urethra at the neck of the bladder; the vagina was absent. It is stated that the Fallopian tubes were found, but they were probably in an imperfect condition.

(*d*) For cases exemplifying these deceptions, *vide* Saviard (Rec. d'Obs. Chirurg., p. 150). Home (Philos. Trans. for 1799). (Ed. Med. and Surg. Journ., vol. i. p. 54.) St. Hillaire (Hist. des Anomal., t. i. pp. 272–277).

(*d*[1]) There is, however, no case recorded in which two testicles, and two ovaries, the essential indices of sexuality, existed in the same persons.

(*e*) A very remarkable case occurring in the 17th century is recorded by Dr. Thomas Allen (Philos. Trans. Abr. i. 24), and another, scarcely less so, is that of Hubert, who died 1767 (Dict. de Méd., xxi. 104).

§ 186. A more recent case, described by two of the most eminent pathologists of Germany, Kiwisch and Kölliker, is of great interest. The individual died at the age of 33 years. The external genitals were, a perfectly normal penis, with a rugose but empty scrotum. The uterus was perfect, somewhat longer than usual, but in its ordinary position. The vagina was rudimentary, and opened into the prostatic portion of the urethra. The Fallopian tubes were 3¾ inches long, with imperfectly developed fimbriæ. The round ligaments had their usual position and attachments. In place of the ovaries were found testes, provided each with an epididymis and a deferent duct which led to the inguinal ring, and, turning to the uterus, followed its sides and finally opened into the prostate gland. This latter body was of normal size; on each side of it were vesiculæ seminales.(*l*) MM. Bouillaud and Manec have reported a case in which the person attained the age of sixty-two years, and had lived and been married as a man. The general appearance was feminine, with the exception of the beard. The external organs consisted only of a penis with the orifice of the urethra at the base of the gland. A loose fold of skin occupied the place of the scrotum. The internal organs were, however, completely feminine, with the exception of the prostate gland, which occupied its usual position. The vagina opened into the membranous portion of the urethra. It is not stated whether the menstrual function was performed.(*m*) A curious and well-described case is that of Ackermann:(*n*) An imperforate penis, a vulva containing a normal testis on each side, a

(*l*) Kiwisch (Klinische Vortraege Abth. II. Prag. 1849). This thoroughly authenticated fact of the coexistence of the prostate and uterus in one individual, is a serious blow to the cultivators of transcendental anatomy, who have maintained its impossibility. Weber, Leuckardt, and many other authors consider the prostate gland to be a rudimentary uterus, or rather the analogue of this organ in the female. Another example of the coexistence of these two organs, in a person 60 years of age, is furnished by Langer. The uterus was attached to the upper part of the prostate gland, and there were two testicles (Archives Gén. de Méd., 5ème sér. vii. 720). An equally marked case (Hemaphroditismus lateralis) of the coexistence of an ovary and a testicle in a new-born child is recorded by Meyer, of Zurich (Virchow's Archiv, xi. 420).

(*m*) Journ. univ. et hebdom. de Méd., t. x. p. 467.

(*n*) Infantis Androgyni historia et iconographia. Jena, 1805.

common vagino-urethral canal, and vasa deferentia opening on either side of the os uteri, but entering the walls of the uterus at the points whence usually spring the Fallopian tubes. Perhaps the most remarkable case of double sex is that examined by Dr. Horace A. Ackley, Professor of Surgery in the Cleveland Medical College, and reported by Dr. George Blackman.(*o*) The person from whom the parts were removed was about twenty-six years of age, and had been employed as a servant. "The history of this individual, as furnished by Prof. Ackley, is briefly as follows: Stature large; external conformation, with the exception of the hips, male; beard moderate; habits solitary, and had a dislike to women; menstruation per penis, monthly; this was always attended with much suffering, and during one of these menstrual periods he died from cerebral congestion. After death, the body found its way to the Cleveland Medical College." Upon dissection the disposition of the sexual organs was the following: "The penis was large, the scrotum empty, a perfect uterus with pervious Fallopian tubes and ovaries, testes on each side above the ovaries and excretory ducts leading from them, a vagina opening into the neck of the bladder, and a prostate gland." The inner surface of the vagina was reddened, and its cavity contained what was supposed to be menstrual blood.(*p*) This statement was after-

(*o*) Am. Journ. Med. Sci., July, 1853, p. 63. Another singular case, exemplifying the condition called lateral hermaphroditism, has been reported by Dr. Banon. The penis was of the usual size in the adult, and imperforate, although subject to erections. Beneath were the external female parts nearly perfect; the orifice of the urethra was placed as in the female, the vagina was rudimentary, but was provided with a hymen, the prostate was absent; the uterus was small, but well formed. There was one testis and one ovary, the vas deferens opened into the uterus. This individual had never menstruated, preferred manly exercises, and in conformation presented a curious intermingling of the characteristics of both sexes. Am. Journ. Med. Sci., July, 1852, from Dublin Med. Press; or fuller, Dublin Quart. Journ., Aug. 1852, p. 66. The somewhat similar case of Angelique Courtois, Follin. Gaz. des Hôp., Dec. 1851, is more particularly interesting, from the fact that the single, well-formed, and undoubted testis had no excretory duct, but lay under a pervious and fimbriated Fallopian tube. There were no ovaries, seminal vesicles, or prostate.

(*p*) Other cases of menstruation through the penis, or from an orifice at its base when imperforate, are on record. One is reported by Dr. Harris, of

wards supported by an examination of the parts made by Dr. W. L. Burnett, of Boston.

§ 187. The necessity, however, of the most minute and conscientious examination of such remarkable cases as this has since become apparent, for we find that the internal sexual organs were not so distinctive as represented. Dr. J. B. S. Jackson, of Boston, in addressing the Society for Medical Improvement on this subject, stated that he had been permitted by Prof. Ackley to examine the specimen. He found no trace of the os tincæ, but the uterus passed insensibly into the vagina. This last was extremely small, measuring in the smallest part, on the inner surface, not more than four or five lines in circumference. Dr. J. found some thickening of the tissues about where the ovaries should be, but it was ill-defined and slight; "and it would not have been thought of, except in connection with the present question." Upon one side an incision was made into this questionable part; but nothing like a Graafian vesicle was seen, nothing but a loose cellular,

Virginia, and another by Dr. Barry, of Connecticut, in which it was necessary to determine the sex on account of a denial of the person's right to vote. (Am. Journ. Med. Sci., 1847, July.) Prof. Simpson, of Edinburgh, states that he has been informed, on credible authority, of two instances where, in males, (?) the menstrual discharge was perfectly regular in its occurrence and considerable in quantity. One of these persons was seventeen years of age, the other had been married for several years, and his wife had no children. (Art. Hermaphroditism, Cyc. of Anat. and Physiol.) Dr. Blackman saw in the Northern Hospital at Liverpool, a sailor from the American merchantman Rappahannock. He says: "This person was about thirty years of age, and, with the exception of the breasts, which were large, had the general appearance of a male. The penis, however, was short, and the scrotum somewhat cleft, so as to resemble in some respects the external labia of the female. At the time of my examination menstrual blood was passing through the penis, and we believe this was a regular monthly occurrence." (Am. Journ. Med. Sci., July, 1853.) A case apparently similar in anatomical conditions to that of Suydam, above referred to, is reported by Dr. Coste, of Marseilles. His patient was 21 years of age, the penis was of the size of a boy's of 12 or 14 years, it was imperforate, and the urethra opened at its base. The menses flowed from this orifice at regular periods. There was no external orifice of the vagina, the perineum was covered with hair, the labia majora were rudimentary, and on the right side there was a body like a testicle. The habitus was feminine, and there was no beard. An operation was performed to make an artificial vagina, and eight months afterwards she was married. (Med. Zeitschrift für Geburtzkunde von Busch, etc., 1836, Bd. 4, H. 2, p. 267.)

or fibro-cellular, tissue. The size and structure of the testicles, so far as examined, were quite normal, and, it is said, that there was an epididymis, although the existence of a vas deferens was not clearly ascertained. The vesiculæ seminales were not found, and the prostate gland, Dr. Jackson says, had not been demonstrated.(*q*)

§ 188. 4th. *Absence of sexual organs.*—Siebold states that he has in his museum a child with no external genitals. Notwithstanding this, two testicles were found in the abdomen. This case is related in full in Faber's "*Duorum monstrorum humanorum descriptio anatomica.*" He also refers to another case of a child, three years old, in whom no internal generative organs were found, and externally only an urethral orifice.(*r*)

§ 189. The foregoing enumeration of anomalous conditions of the sexual organs will suffice, we think, to convince the reader, upon careful examination, that the determination of sex in a living person presenting any of those which are external, is attended with much difficulty, in consequence of the absence of a uniform correspondence between the outward and inward defects. It will also be seen from some of the cases, that reliance cannot be placed upon the general conformation of the individual nor upon the tastes and habits, since experience shows that the indications derived from them are often fallacious. Practically, therefore, the question must often remain unresolved, or be determined solely by the sexual predominance in the external organs alone. It may be observed, however, that the rarity of *real* duplicity of sex, or of the complete absence of the sexual organs, compared with the

(*q*) Am. Journ. Med. Sci., Oct. 1853. For other cases *vide* Beck's Med. Jurisprudence, and St. Hilaire's Histoire des Anomalies, t. ii. p. 99.

(*r*) For similar cases *vide* Ström in Svenska Lakaré-Saellskapets Handlingar, Bd. i. H 1. Also in Am. Journ. Med. Sci., vol. ii. Also in Henke's Zeitschrift, Bd. 44, § 185. A stillborn seven months' child had no external genitals. A very singular example of this malformation is published by Goschler (Prager Vierteljahrs, 1859, iii. 89). It was presented by a man twenty-seven years old. There was no penis, but the mons veneris and scrotum were perfect, and behind the latter and just in advance of the anus, was a small opening which gave exit to the urine, and to sperm also when an erectile fleshy excrescence upon its edge became excited by friction.

ordinary cases of presumed hermaphroditism, from the penis being imperforate, the testes not descended or the clitoris excessively developed, is so extreme, that the question will, in its legal relations, seldom require elucidation.

§ 190. In conclusion, we cannot forbear referring to an instance (*s*) in which an operation was performed with the object of depriving a child "of that portion of the genital apparatus which, if permitted to remain until the age of puberty, would be sure to be followed by sexual desire, and which might thus conduce to the establishment of a matrimonial connection." The child was three years old, had been considered a girl until the age of two years, when she began to evince the tastes, disposition, and feelings of the other sex; she rejected dolls and similar articles of amusement, and became fond of boyish sports. "There was neither a penis nor a vagina; but, instead of the former, there was a small clitoris, and, instead of the latter, a superficial depression, or *cul de sac*, covered with mucous membrane, and devoid of everything like an aperture or inlet. The urethra occupied the usual situation (*t*) and appeared to be entirely natural; the nymphæ were remarkably diminutive; but the labia were well developed, and contained each a well formed testis, quite as large and consistent as this organ generally is at the same age in boys." After mature consideration an operation was resolved upon and the testes removed. They, as well as the spermatic cords, are described as being *perfectly formed in every respect*. Three years after the operation the disposition and habits of the child had undergone a material change, and she took delight in all feminine occupations. The author proposes this example as a precedent in similar cases. We sincerely hope that it may not be followed. The operation removes merely the *external*, and in cases like this the very distinct evidence of sex, and hence only adds to the doubts of the rightful sexual character. It

(*s*) Case of Hermaphroditism, involving the Operation of Castration, and illustrating a New Principle in Judicial Medicine. By S. D. GROSS, M.D., Prof. of Surgery in the Medical Department of the University of Louisville.

(*t*) Whether this was the usual situation in the male or female does not appear; it was probably the latter.

does not necessarily extinguish the sexual instinct, nor deprive the person of "his only incentive to matrimony," and, finally, in no way relieves him from the odium or aversion with which the malevolent or ignorant may regard him.

CHAPTER II.

SEXUAL DISABILITY.

§ 191. 1st. *Sterility.*—The causes of sterility are numerous. Many of them are known and some of them are curable; but there are also many altogether beyond the power of medical science to discover or remedy. Among the removable causes of sterility may be first mentioned an *imperforate hymen.* This membrane is sometimes quite thick, dense, and fibrous in its structure, opposing a complete obstacle to the passage of the catamenia, and rendering impregnation impossible.(*u*) It is remedied by incision and gradual dilatation. If the hymen be not, however, completely imperforate, impregnation may occur. Of this fact examples are recorded by Baudelocque, Nysten, and others. A more recent case is furnished by Dr. Howard Smith.(*v*) The vagina may be, congenitally, extremely narrow, or have become occluded from inflammation and its consequences. The mouth of the womb is also subject to the same accident, and this, in connection with a narrowing of the upper portion of the vagina, is supposed to be a frequent cause of sterility. In all these cases, however, a cure is possible.

Menstrual irregularity, displacements of the uterus, with extreme irritability of this organ, prolapsus, intra-uterine tumors, such as polypi, are frequent causes of sterility, but are also generally under the control of the physician. Some authors have stated that uterine cancer is a certain cause of

(*u*) For cases, see Brit. and For. Med.-Chir. Rev., xxi. 552.
(*v*) New Orleans Med. News, June, 1858.

sterility; this opinion is, however, not sustained by facts, numerous instances being recorded of impregnation in this disease. Dr. Lever mentions several cases. Siebold says that he has, in his pathological collection, a cancerous uterus containing a seven months' child.

§ 192. Of the absolute and incurable causes of sterility, those depending upon *malformation* are the only ones of practical importance. An imperfect development of the sexual organs has been frequently described. The following are some of the more striking cases:—

§ 193. Dr. Meigs relates a case of entire absence of the vagina, the external sexual organs being perfectly natural. An incision was made, by Dr. Randolph, three inches and a half in depth, but he could find no vagina.(*w*) Dr. Oldham reports the case of a servant girl, whose health had been delicate for some time. "She had not menstruated, suffered periodical pains in the pelvis, or any vicarious bleeding. She had a dull, inanimate, and rather timid look, with the voice and articulation of a delicate female. Her mind was apathetic, and she was sexually indifferent. The chest was flat, and the mammary glands scarcely developed. The pelvis was well formed. The mons veneris, external labia, nymphæ, and clitoris were normally developed, and the first covered abundantly with hair. The situation of the orifice of the vagina was occupied by a raised raphe of mucous membrane, but there was no aperture." A catheter being introduced into the bladder, and the finger into the rectum, no solid intervening structure and no trace of uterus could be discovered.(*x*) In the case of a married woman, who died at the age of seventy, the internal organs were but slightly developed, and a shallow depression represented the vagina. On inspection from within the pelvis, this organ was found to be totally wanting. Rudimentary ovaries existed in the abdomen, and rudimentary separate halves of the uterus were found in the pelvis.(*y*) Two other examples, in all probability, of the same malforma-

(*w*) Velpeau's Midwifery, p. 114.
(*x*) Guy's Hosp. Rep., vol. vi. p. 362.
(*y*) Edinb. Month. Journ., N. S., vii. 230.

tion are reported, the one by Dr. J. M. Warren,(*z*) and the other by Dr. C. Coates.(*a*) Troschel relates the case of two sisters in whom the uterus was wanting.(*b*) Siebold examined a woman, twenty years of age, in whom the vagina was like that of a new-born child; no uterus could be discovered by an examination *per rectum*.(*c*) Dr. Rüttel had under his care a woman twenty-seven years old, of small stature. The external genitals were like those of a child of nine or ten years of age; the vagina was smooth, very narrow, and hardly two inches long; the mouth of the uterus hardly preceptible, and the uterus itself of the size and shape of an olive. The breasts were undeveloped.(*d*) A curious case is quoted by Siebold, in which, although there were no external sexual organs whatever, nevertheless the woman became pregnant. The impregnation was effected through the rectum, in which a small orifice communicated with the vagina. At the approach of labor, this opening was widened by the knife, and the woman was delivered of a child which lived six hours.(*e*) Mr. Hunt related to the Medical Society of London, the case of a lady, aged thirty, of refined mind and feminine development, who consulted him for stricture of the rectum. The meatus urinarius was more capacious than usual, and there was no *vaginal aperture*, the perineum being continued from the anus to the meatus. No trace of the fundus uteri or of ovaries could be felt by the rectum. The clitoris and labia were normal, the mammæ well developed, and sexual feeling was admitted to

(*z*) Bost. Med. and Surg. Journ., May, 1857, p. 297.

(*a*) Times and Gaz., July, 1858, p. 6.

(*b*) Rust's Magazin, Bd. 37, S. 163; Gaz. Méd., 1851, p. 9, by Dr. Zeihl, of Nuremberg. Total absence of uterus in a woman fifty-seven years of age, observed after death. Dr. Meigs relates two cases of total absence of uterus, but with otherwise perfect sexual development, in his own practice. (Treat. on Obstet., p. 131.) Dr G. S. Crawford gives another case of absence of uterus. (N. W. Med. and Surg. Journ., Nov. 1850.) Dr. Cummings found the uterus half an inch long, and the ovaries mere lines, in a woman who had never menstruated. (Ed. Month. Journ., Sept. 1854, p. 275.) Dr. Chew, of Baltimore, observed a case in which the uterus was absent. The woman was twenty-two years of age, and had never menstruated. (Am. Journ. Med. Sci. 1840, p. 39.)

(*c*) Handbuch, p. 91.

(*d*) Henke's Zeitsch. Bd. 47, S. 250.

(*e*) Handbuch, p. 88.

exist, probably in its normal degree. She had never menstruated, nor had there been any vicarious discharge or periodical inconvenience. Dr. Murphy mentioned a case in which the vagina terminated in a *cul de sac*, and there was no sign of a uterus. The woman was handsome and well formed.(*f*) A most curious, and we believe unique case is that recorded by Morgagni (67ème lettre, § 7), of a woman whose vagina opened in the abdomen *above the umbilicus*, and who became pregnant, and was delivered of a living child by a cutting operation from which she recovered.

§ 194. Finally, there are some causes of sterility which are relative in their nature. Such a disproportion between the genital organs of the two sexes as to render intercourse extremely painful to the female, may be taken as an example. Other causes, of a psychical nature, are sometimes as operative as the physical impediments before spoken of. For the most part they are exceedingly intangible in their nature. In the *causes celébres* an amusing instance of want of sexual harmony is given by Pitaval. Two gentlemen of rank, very much of the same age and personal appearance, were both married to wives who proved unfruitful after several years of marriage. The two couples at last determined to proceed to a celebrated watering place, in the hope of deriving some benefit from the change and the use of the springs. On the way, they put up at an inn and retired for the night. But the two wives had preceded their husbands to bed, and each of the latter mistook his friend's room for his own. In consequence of the mistake, both of the ladies proved with child.

§ 195. The functions of menstruation and reproduction are generally coincident. Hence, as a general rule, a female is not susceptible of impregnation before the catamenia have appeared nor after they have ceased. Like all other physiological rules, these will be found to have exceptions. Many instances are on record in which women who had never menstruated have become mothers.(*g*) Cases of precocious menstruation are also numerous, and many of them well attested.

(*f*) Am. Journ. of Med. Sci., July, 1872, p. 275.

(*g*) *Vide* Whitehead on Abortion, etc., p. 223; also Capuron, Méd. Lég. des Accouchemens, 96.

§ 196. Mr. Whitmore relates an interesting instance of precocious development in a female child. The catamenia appeared a few days after birth, and returned at regular intervals of three weeks and two or three days until her death, at the age of four years. The development at this age was equal to that usual at ten or eleven. The mammæ were unusually large; the mons veneris was covered with hair, and the development of the genitals was considerable. It is stated that she manifested at her monthly periods the reserve usual to women at such times.(*h*) Dr. Charles Wilson, of Pennsylvania, met with a child five years old who had menstruated irregularly from the fifth month of her life. She was of the usual stature of children of her age, but very stout and fat. Her breasts were about the size of a well-developed adult virgin's, and the pudendum was thinly covered with black hair.(*i*)

§ 197. Velpeau quotes the case of a young girl, in the Havana, whose menses appeared at the age of 18 months, and continued regularly afterwards. The child, moreover, exhibited in her development all the characteristics of puberty. A girl at New Orleans was born in 1837 with her breasts developed and the mons veneris covered with hair. Her catamenia appeared at the age of three years, and continued to return every month thereafter. A case is mentioned in the Lancet where menstruation commenced at the age of two years.(*j*) Another is reported where it began in the tenth year; the girl became pregnant between the eleventh and twelfth, and bore a child.(*k*) A similar case is reported by Dr. J. B. Walker, in which menstruation commenced at the age of eleven and a half years, and the girl was delivered of a child when only twelve years and eight months of age.(*l*) Rüttel refers to a case by Haller, where a girl of nine years of age became pregnant; and D'Outrepont met with others of pregnancy at the ages of nine and

(*h*) Am. Journ. Med. Sci., Oct. 1845, p. 430, from Ed. Month. Journ. of Med.

(*i*) Philada. Med. Exam., Dec. 1853, p. 746.

(*j*) Jan. 29, 1848. (*k*) Lond. Med. Gaz., Nov. 1849.

(*l*) Bost. Med. and Surg. Journ., Sept. 9, 1846.

thirteen.(*m*) Another instance may be added in which menstruation commenced in the first year and pregnancy in the ninth. The girl was delivered of a child weighing seven and three-quarter pounds. The case occurred in Kentucky, and is reported by Dr. Rowlett.(*n*) Mr. Smart has given an account of a girl who was born at Manchester, Eng., and began to menstruate at the age of three years and six months, and continued regularly to do so until the date of the observation, when she was four years and five months old. She had then the aspect of a woman of small stature, a full bust, prominent breasts and nipples, and hair an inch long upon the pubes.(*o*)

§ 198. A. Menzel reports the most recent case.(*p*) The breasts were noticed to be unusually developed immediately after birth, and, when the girl was four years old, had attained the size usual at eighteen. At the age of four years there was a reddish discharge from the genitals, while the labia majora and mons veneris were covered with moderately thick hair, and the uterus could be felt through the rectum. Except, however, some bashfulness at the time of the examination, the child had no feelings different from other girls of her age.

§ 199. The usual period for the *cessation of the menses* and, consequently, the capacity for child-bearing, is from 45 to 50 years; but cases could easily be multiplied showing that occasionally they continue even to the age of 75 years. Indeed, a case is quoted by Orfila in which they continued until the 99th year. This woman menstruated first at the age of 20, bore her first child at 47, and her seventh and last at 60.(*q*)

§ 200. Many of the cases in which menstruation in old women is reported are probably apocryphal—hemorrhage proceeding from some disorganized tissue being mistaken for it. Nevertheless, many of these instances of late menstruation and pregnancy are genuine. When the monthly periods continue to return after the ordinary time for their cessation, the female remains susceptible of impregnation, but she will rarely be capable of conceiving after this function had ceased. The only

(*m*) Henke's Zeitsch. 1844. (*n*) Transylvania Journ., vol. vii. p. 447.
(*o*) Times and Gaz., July, 1858, p. 98.
(*p*) Wien Med. Wochenschrift, 1871. (*q*) Méd. Lég., 4ème ed. 1, 257.

case that we have met with is one quoted by Dr. Taylor, from the *Lancet*, in which a lady became pregnant between eight and nine months after the final cessation of the discharge. In this case, however, the lady was only 44, and consequently had not arrived at the usual season for its cessation. The discharge had, it is stated, been decreasing gradually for nearly two years before it entirely ceased. If this function continues, however, the woman is liable to conceive. Dr. Rüttel observed in twelve women that they bore their last children between the ages of 45 and 50. He refers to a case in Schmidt's Jahrbuch in which a woman who was married at 19 did not bear a child until she was 50 years old.(*j*) Ottinger and Cederschjöld met with cases of parturition and menstruation at the ages of 50 and 53; and Nevermann(*k*) found, out of 1000 cases, that 436 children were born by females at the following ages: 101 at 41, 113 at 42, 70 at 43, 58 at 44, 43 at 45, 12 at 46, 13 at 47, 8 at 48, 6 at 49, 9 at 50, 1 at 52, 1 at 53, and 1 at 54 years. From these facts, it is evident that the ordinary limits of the function of gestation are occasionally anticipated or transcended. Note must be taken of these rare exceptions in estimating the probabilities in any doubtful case.

§ 201. 2d. *Impotence.*—By this word is here meant the want of procreative power in the male, whether arising from a faulty condition of the external or internal organs of generation, or from any moral or physical causes. The causes of impotence are extremely numerous, and often obscure. Some of them are remediable by art and time; others are permanent and incurable. They may be conveniently examined by a division into those which depend upon the secreting portion of the generative apparatus, and those which depend upon some deviation of the copulative portion from its normal condition.

§ 202. (1) *Congenital absence of the testes.*—The only satisfactory example of this defect is a case related by Dr. Fisher, of Boston, in the twenty-third volume of the *American Journal of the Medical Sciences.* The post-mortem examination was minute and careful. All of the accessory parts of the seminal appa-

(*j*) Henke's Zeitsch. 1844, p. 251. (*k*) Ibid.

ratus were present, except the testes. The penis was undeveloped, and the individual, who was forty-five years of age, had never experienced any amorous desires. There were a few scanty hairs upon the pubes, but there was no beard; yet the constitution was vigorous, and the habits of the person active. It is seldom, however, that this deficiency can be safely asserted during life, for, although the scrotum be empty, yet the testicles may have been retained in the abdomen. While in this situation, they may be rudimentary and defective, or not; for experience has shown that some *crypsorchides* have been remarkable for their sexual powers. One of the most remarkable cases of premature sexual development coinciding with non-descent of the testes, and reported by Dr. Lopez, of Mobile, in the *American Journal of the Medical Science*, 1843, p. 500, is that of a mulatto boy, aged three years ten months and fifteen days. His weight was eighty-two pounds; height, four feet and half an inch; width around chest, twenty-seven and a half inches; thigh, nineteen inches; head, twenty-two inches; length of penis at rest, four; circumference, three and a half; testes not descended; has whiskers, and hairy axillæ; and lifts a man of one hundred and forty pounds. The habit of body, scantiness of beard, and feminine voice, are not always safe indications of the absence of the testes, or of their defective condition, should they have been retained within the abdomen or in the inguinal canal. Our opinion in these cases should be very guarded, since the organs upon whose condition it is required cannot be inspected. In some cases, one testis only has descended; but if it be not diseased, the individual will be quite capable of fulfilling his conjugal duties. The rarity, however, of either of these conditions, may be judged from the fact, that in 10,800 recruits, Dr. Marshall found only eleven in whom a single testis had descended, and one where both were retained in the abdomen.

§ 203. (2) *Castration.*—If one testis only be lost, whether by accident, disease, or extirpation, the virile powers will not be impaired, unless the remaining one be imperfect or diseased. But, if the individual have lost both of these organs, he becomes, of course, incurably impotent. Yet it is a question of some medico-legal interest, whether impotence is an immediate

result. A man who was castrated by Sir Astley Cooper stated that he retained the sensation of emission for twelve months, and the power of copulation, at rare intervals, for ten years, after the operation. Otto found the vesiculæ seminales still full of semen in a man who died nine months after he had castrated himself.(*l*) Ricord mentions the case of a man who was castrated on account of disease of both testes; he was also affected with a tumor of the cerebellum. He had, nevertheless, erections, and the most violent sexual desires.(*m*) Krahmer relates that a man who had excised both testicles with a razor, had an involuntary emission of semen on the eleventh night after the operation.(*m*[1]) Some of the older authors(*n*) assert the possibility of fruitful intercourse after the loss of the testes, giving instances in illustration of it. It is also asserted, upon the authority of Aristotle,(*o*) Varro,(*p*) Sanchez,(*q*) and others, that animals have been known to be capable of propagation soon after they have been castrated. That the fact is authentic as regards animals may be admitted, without giving assent to the possibility of a like transaction upon the part of man. It is conceivable that an animal might attempt sexual intercourse immediately after castration; but the case has yet to arise in which the question of paternity would hang upon the decision as to the possibility of a man being capable of the same attempt.

§ 204. For how long a time, then, after castration, can the faculty of generation be retained? We believe that this question has yet to be answered. The cases cited above do not solve it. The erectile faculty of the penis is retained in eunuchs, if they have been castrated after the age of puberty, and is in itself alone, or when attended with sexual desire, not indicative of procreative power. Nor is the sensation of emis-

(*l*) Handb. der Pathol. Anat., p. 344.

(*m*) Bull. de l'Acad. de Méd., 1851, p. 687.

(*m*[1]) Handbuch d. ger. Med., 1851, S. 276.

(*n*) Venette, Leipzig, 1698; Nic. Fontan, Obs. rar. Amstelod., 1641.

(*o*) Historia Animal., lib. i. cap. 4; lib. ii. 13.

(*p*) Re Rustica, lib. ii. cap. 5, "de quibusdam bovibus admirandum scriptum inveni, exemptis testibus, si statim adnosseris concipere."

(*q*) Sanchez, de Matrimonio, Lugdun. Batav., 1669.

sion, or even the actual extrusion of a liquid having some of the sensible qualities of the semen, sufficient evidence of it. Unless a microscopic examination reveal the presence of spermatozoa, which alone are characteristic of the fruitful semen, there can be no certainty that the secretion is more than the *liquor prostaticus*, or mucous discharge. The observation of Otto is, therefore, not complete. As for those instances in which pregnancy is said to have resulted from the cohabitation with their wives of husbands who had sustained the loss of which we are speaking, it is a matter of regret that the connection in them between cause and effect is not susceptible of demonstration.

§ 205. (3) *Diseases of the testes.*—These are numerous, but usually implicate one of the organs only: hence, as has been said before, if the remaining testicle be not affected, or if, indeed, as is sometimes the case, only a part of the structure is destroyed, the person will not be rendered impotent. It will not be necessary for us to dwell upon the special diseases to which the testis and its appendages are liable. A safe opinion, in cases of alleged impotence from disease of the testes, can rarely be given, since it is impossible to know to what extent the true glandular structure is affected. The physician will probably be compelled to judge from the same facts which are equally open to others. In addition, however, to the diseases arising from inflammation and morbid growths which are the most common, the testis is liable to become atrophied, from various causes. Thus, large double herniæ are said to have produced impotence by pressure, and the same is asserted of hydrocele. One or both testes may be attacked in the course of *cynanche parotidæa*, or mumps, and waste away in consequence. Atrophy of the testicle, and impotence, may sometimes be produced by mechanical injury to the spine, or to the occiput. Both Larrey and Hennen mention cases in which, from blows with a sabre upon the occipital protuberance, impotence resulted. Dr. Fisher,(*r*) of Boston, had a case in which the loss of virile power was only temporary, after an injury of a similar character. Larrey states that many of the

(*r*) Am. Journ. Med. Sci., vol. xxiii.

soldiers in the French expedition to Egypt became impotent from atrophy of the testes, which he ascribed to the use of date-brandy sophisticated with *solanum capsicum* or *pseudo capsicum*.

§ 206. In some cases, the inability to procreate arises from some defect in the copulative organ.

(4) *Defect in size and malformation of the penis.*—The general rule may be laid down, that, if the organ be of sufficient size to be introduced within the entrance of the vagina, fecundation may be the result. Hence, except the penis be congenitally absent, or have been removed close to the pubis, the person is not necessarily incapable. In case of hypospadias or epispadias, *i. e.*, where the orifice of the urethra is either below or above the organ, at some point of its length, the individual may become a father, if the orifice can be brought within the female parts. Cases proving this fact satisfactorily are reported by Foderé, Belloc, Kopp, and others;(*s*) in some of which instances the malformation was transmitted to the children. A very interesting case of this nature is reported by Traxel.(*s*[1]) An unmarried woman, at her confinement, deposed that for three years she had not cohabited with a man, but only with a female whose sexual organs bore some resemblance to those of the male. On examination, this person was found to present the following peculiarities. A scrotum was divided in the middle, and on either side contained a testicle. Between its two halves there was a fissure lined with a mucous membrane, and presenting at its upper angle and below the penis the orifice of the urethra. The penis was short, thick, and imperforate, and along its under surface, in the natural position of the urethra, was a deep furrow extending from its root to its extremity. The new-born child presented the same malformation precisely. In this case it is evident that during coition the open urethral furrow was transformed into a canal by the apposition of the vaginal membrane, and conveyed the semen to the uterus. The person hitherto regarded as a woman was judicially ordered to assume

(*s*) Beck's Med. Jur., vol. i.

(*s*[1]) Prager Vierteljahrs., 1856, 4tes Bd. Anal., p. 103.

man's clothing, provide for the support of the child, and declared capable of contracting marriage. This defect is also in some cases curable by an operation. Examples of bifid penis,(*t*) and cases in which this organ had an unnatural attachment to the abdomen (*u*) and to the scrotum,(*v*) are to be regarded rather as medical curiosities, than as likely to give rise to practical difficulty in legal relations. The same may be said of an excessive size of the penis.

§ 207. (5) *Obstruction from large hydroceles, or herniæ.*—This is sometimes an effectual hindrance to copulation, if voluminous. A case is related where a man of fifty-one years of age, who had been affected with a scrotal hernia for nine years, was nevertheless able to beget children, since, in the horizontal position, the tumor became a third smaller, and allowed the protrusion of the penis.(*w*) An interesting case is related in Henke's Zeitschrift, in which the paternity of a child was attributed by the mother to a married man of sixty years of age. It was represented, in his defence, that he was affected with a double scrotal hernia of ten years' standing, which rendered the sexual act impossible, since the penis was almost entirely concealed by the immense tumor, measuring in circumference 18¾ inches. A very careful examination and report was made by the official surgeons; they declared that this state of the parts did not hinder the act of coition, since the tumor was of such a yielding nature as to allow, by proper manipulation, of the sufficient protrusion of the organ.(*x*)

§ 208. (6) *Local relaxation.*—Constitutional causes often impair the sexual power, not only by rendering the seminal secretion inactive, but by destroying the ability to copulate. Excessive abuse of venery, and the vice of masturbation, are the most frequent causes of that local relaxation which often

(*t*) Ephem. Nat. Curios. Dec. 1, Ann. 1, Obs. 110, Dec. 3, Obs. 77; Sixtus D. de diffusione genitalium, singulari penis bifidi observatione illustrat; Kopp. Jahrbuch, vii. p. 386. The preparation is in the Anatomical Cabinet in Würzburg.

(*u*) Schurig, Spermatologie, p. 134.

(*v*) Cheselden's Anatomy, p. 314; Brand. Ed. Encycloped. Art. Hermaphrodites.

(*w*) Pyl's Aufsätze, Sammlung viii. s. 204. (*x*) Band 44, s. 379.

constitutes an insuperable obstacle to sexual intercourse. If impotence be ever caused by the use of colchicum, nitre, camphor, dulcamara, and other drugs, as is alleged, the defect will be, most probably, only of a temporary nature.

§ 209. (7) *Psychical causes.*—These are, in some cases, hardly explicable by the individual himself. Cases are on record in which, notwithstanding the existence of proper sexual feelings on the part of the husband, he has been unable to accomplish that part of the act which is essential to impregnation. Devergie relates a case of this kind.(*y*) Another one is given by Dr. Strecker.(*z*) In both cases, the husbands had the sensation and the knowledge of emission with other women. In one of these cases, this circumstance was attributable to indifference on the part of the female. Generally, where relative impotence exists, it will depend, in the absence of physical causes, upon some prejudice or passion. Excessive sexual desire will sometimes defeat its own end; and, on the other hand, too great timidity, or disgust and aversion, may prove causes of impotence. We need hardly add, that they are often but temporary in their nature.

§ 210. (8) *Want of age.*—The seminal secretion is established at the age of puberty, which is about the fifteenth year in temperate climates, and ceases at no determinate period. The establishment of this secretion is marked by familiar changes, both local and general. The genital organs become developed, hair appears upon the pubes and under the axillæ, the beard becomes apparent, the voice more grave, and the muscular system developed. Curious instances have been reported, in which there has been unusual sexual precocity. The most astonishing of these is one related by Professor Stone, of Washington.(*a*) The child was only *four* years old; he was four feet and a quarter of an inch in height, and weighed nearly seventy pounds. His bones and muscles were developed in an extraordinary degree, his voice was grave, and the pubes was covered with a luxuriant growth of hair. The penis

(*y*) Méd. Légale, Nullité de Mariage.
(*z*) Henke's Zeitschrift, 1840, 1 H. p. 223.
(*a*) Am. Journ. of Med. Sci., Oct. 1852.

measured, in a semi-flaccid state, four and a quarter inches in length, and when perfectly flaccid three and a half inches. The prepuce was short, leaving exposed a perfectly formed glans penis. The papillæ of the corona glandis were salient, and exquisitely sensitive. In the scrotum were two firm, apparently well-developed testicles, perhaps rather under the average size of those organs in the adult. The spermatic cords were distinct, and, under the finger, gave the impression of perfect organs. His father having observed "during the night, when he had slept with him for the first time, a constant erection of the penis, accompanied by a nickering, like an excited stallion," consulted Dr. Stone concerning him. The boy was said to be extremely fond of embracing the opposite sex, and on one occasion, when in bed with a near relative, a married lady, the latter was aroused by finding him closely clasped to her back, and her night-dress saturated with a glutinous material—very different from that she expected, as she supposed he had emptied his bladder upon her. The reporter had no opportunity of examining the secretion with the microscope.

Dr. Rüttel observed a case in which a girl of fourteen became pregnant by a boy of the same age.

Mr. Ruelle, of Cambria, has recorded an example of precocious virility. A child three and a half years of age, muscular and strong as one of eight, had all his male organs of the full adult size, with long black hair on the pubes, and, under excitement, discharged semen four or five times daily. He had also a full male voice, and dark short hair on the cheek and upper lip.(*b*)

§ 211. Old age is usually attended with impotence, but there is no fixed period at which, either medically or legally, a man must cease to be capable of begetting children. Mr. Curling has found the spermatozoa in the semen of men at sixty, seventy, and even eighty-seven years of age, and Casper in a man of sixty-nine. Parr is said to have become a father at the age of 140 years; and quite a sufficient number of instances are known, to determine the fact of the occasional retention of virility much beyond the age of sixty years. The preserva-

(*b*) Brit. and For. Med. Rev., Jan. 1844, p. 277.

tion of this faculty coincides with a vigor and haleness of constitution which is the lot of but few aged men.

Curling has shown(b^1) that there may be perfect virility without the presence of spermatozoa, in which case, of course, the ability to propagate is absent; and Mr. C. thinks that, where this condition is known to exist, it presents a bar to marriage, but is insufficient ground for a divorce.

Delpech says,(b^2) that workmen engaged in making red toy balloons, in which process sulphide of carbon is extensively used, at first pass through a stage of excitement with intensified sexual desires, but finally lose all such inclination; it is even stated that the testicles of boys engaged in this work never develop, and that analogous effects are produced in women, who eventually become sterile after passing through a period of venereal excitement.

These statements would certainly seem to require further and confirmatory observations before a judicial decision could be based upon them.

It should also be borne in mind that a single microscopic examination is not sufficient, as Casper has shown that spermatozoa may be absent at one time and present at another.

CHAPTER III.

RAPE.

§ 212. MEDICAL evidence in cases of rape is seriously affected by circumstances over which the physician can have no control. One of the most important of these is the want of an examination at a *sufficiently early period* to afford useful results. In genuine cases, where rape has been really attempted, the local marks of violence are often extremely insignificant, and consequently soon disappear. A slight contusion of the genitals, a laceration of the hymen, or a trifling discharge of blood,

(b^1) Lancet, vol. ii. 1863, p. 11.
(b^2) Ann. d'Hygiène, Jan. 1863, p. 65.

are the sole indications of the transaction, and may, within forty-eight hours, be no longer present. Hence, it is seldom possible for the medical examiner to make any useful note of "the marks of violence upon the person, the disorder of the clothing," etc., which are usually prescribed by authors. The dress has been smoothed or changed, the marks of injury have disappeared, and all that remains is perhaps a suspicious stain upon a chemise, *alleged* to have been worn at the time of the assault. It is stated by a celebrated author, who has had much experience in such cases (Casper), that in fifty-eight cases which he had been required to examine, the time that had elapsed from the alleged commission of the rape varied from three weeks to one year. In connection with the injuries above alluded to, the victim of rape, particularly if young and a virgin, often manifests by her manner of walking, *i. e.* by keeping the limbs separated, that she suffers pain in the genitals. She is also apt to complain of pain in passing her urine or in going to stool. These signs are naturally most conspicuous immediately after the act of violence, and, apart from aggravating causes, may be expected to decline from day to day.

§ 213. 1st. *Rape upon children.*—We propose in the present article to refer a good deal to the experience of Casper, believing that the subject will be more profitably illustrated by authentic cases, than by theoretical discussions. There is no subject upon which it is more necessary for the physician to be guarded in his opinion than this, since he may be designedly entrapped into an admission entirely at variance with his real view of the case.

Thus—a tradesman of irreproachable character was accused by a woman of having violated her daughter, who was but eleven years of age, and of having communicated to her a gonorrhœa. The child was of a very scrofulous constitution. The labia majora were separated and flaccid, the clitoris unusually developed, the entrance of the vagina inflamed, and painful to the touch, and the hymen obviously stretched. There was also a copious urethral discharge. The opinion given by Dr. Casper was, that a complete penetration had not taken place, but efforts by the male organ, affected with gonorrhœa, had been made to effect it. The further pro-

gress of the case showed the truth of this opinion but not of the accusation, for the defendant was found perfectly free from disease, and the cross-examination developed the fact, that the mother, after having fruitlessly endeavored to extort money from the tradesman, had delivered the child to her own paramour, a journeyman living in the same house, whom she knew to be affected with gonorrhœa. She then threatened to denounce the tradesman, unless he gave her money.

§ 214. In thirteen cases of alleged rape on children from two and a half years to fourteen, he found, upon examination, nothing whatever to support the accusation, as the sexual parts were in a perfectly natural condition. Yet many of these cases had been previously examined by physicians, and were provided with certificates attesting various degrees of injury. In two cases the accused parties were also said to exhibit unmistakable traces of the previous existence of chancres. Dr. Casper ascertained that the children were wholly uninjured, and that the presumed venereal cicatrices were perfectly natural appearances.

§ 215. It is also important to know, that it is by no means easy to ascertain the condition of the hymen, especially in children, who present a majority of the cases. There are two reasons for this. 1st. Where the outrage has been really committed, the tender parts of the child become so sensitive, in consequence of their inflamed and swollen condition, that they will not bear the slightest touch, much less a separation of the labia; the child becomes so uncontrollable, that it is often necessary to give up entirely the examination without attaining the desired end, and this repeatedly, if the physician happen to be inexperienced, or unless an anæsthetic is administered.

§ 216. The second reason is based upon the variety of structure presented by the hymen. It is not always crescentic, but frequently is attached all round to the vagina, having a circular hole in the centre. This free edge is sometimes swollen and loose, and is then particularly deceptive. It varies a great deal in thickness and firmness. Its place of insertion also varies, it being sometimes attached near the entrance of the

vagina, and at others so far back that it is found with difficulty, especially under the circumstances before referred to. "For these reasons," says Casper, "the cases are explicable, which I have so frequently met with, where a previous medical or surgical examiner had certified that the hymen was absent, when I myself have afterwards found it entire and uninjured."(*c*)

In order to have a clear understanding of medical evidence in cases of rape, the subject may properly be considered under the divisions of, 1st. *Rape upon Children.* 2d. *Rape upon Adults.* We here refer, however, only to the outrage upon persons of the female sex; the crime in a contrary sense will be considered hereafter.

§ 217. 1st. The *frequency* of attempted rape upon children has been lately shown by Casper. Of one hundred and eleven cases which he had examined up to the close of 1856, seventy-eight were children under twelve years of age, and seventeen between the ages of twelve and fourteen. It is probable that very nearly the same proportion might be observed in other places if proper statistical inquiry were made. This frequency may be accounted for by the comparative ease with which a child's resistance may be overcome, and by its entire ignorance of the nature and consequence of the sexual act. We may also mention here, that the author above quoted refers it, as well as the superadded disgrace and misery of venereal infection, to the prevalent superstition among the lower classes in his country, that connection with a pure virgin will cure a person affected with this disease, and hence, for the sake of certainty, the youngest children are chosen as victims of this revolting crime.(*d*) Casper found syphilitic gonorrhœa in thir-

(*c*) Casper, loc. cit.

(*d*) The supposition exists in other countries. Mr. Wilde, of Dublin (Med. Times and Gaz. Sept. 10, 1853), says: "A delusion prevails very extensively among the lower orders in Ireland, to the effect that a man can get rid of an obstinate gonorrhœa, which has 'foiled the doctors,' by having connection with a virgin, and, as the easiest mode of effecting that object, a child of tender years is selected." He states also that he had been informed by Dr. Montgomery that he knew a case in which a servant woman, affected with gonorrhœa, induced a child to have connection with her, in the hope of thus curing herself. From the work of Duchesne on the prostitution of

teen girls from five to fourteen years of age. One of them, aged only five years, had moreover venereal warts, and in a child of three years of age he found a primary chancre.

§ 218. The traces left after an attempt at sexual connection by an adult with a girl under the age of puberty vary somewhat with the *age*, but more still with the degree of violence and the frequency of its repetition. A full and complete connection between an adult male and a child under twelve years of age is, on the first attempt, manifestly impossible; repeated efforts, however, will produce such a dilatation of the parts as to render it finally practicable. A case, where the vagina of a child seven years of age became by degrees sufficiently dilated to admit the adult male organ completely, is mentioned in Canstatt's Jahresbericht for 1851. But in the majority of cases the penetration is but partial, and in some cases the chief injury has been inflicted by the use of the finger. The truth of this statement is shown by the frequently uninjured condition of the hymen. In fifty-one cases of rape upon children, many of them under fourteen, complicated with syphilis, Casper found the hymen destroyed only seven times in those between nine and fourteen years, and twice slightly torn in children of nine and ten years of age. In all the remaining cases, viz., *four-fifths of the whole number, it was entirely uninjured.*

§ 219. The usual *marks of violence* left after the attempt upon children are a swollen condition of the labia majora, together with an inflamed and painful state of the vaginal entrance, and a secretion from these parts of a muco-purulent discharge. There is also pain in urination and defecation.

This condition may be illustrated by a case where a child ten years of age was assaulted by a man aged thirty-eight; the following signs were found immediately afterwards. The nymphæ swollen, of a dark red color, and very painful, the hymen torn into three parts, the vaginal entrance free, but of a deep red color as far as the attachment of the hymen. The

Algiers, we learn that "the Arabs believe that the syphilis may be transmitted to a negro female, the individual thus transmitting it becoming free from the disease."

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child was feverish and had pain in and after urination. Spots of blood were found on the under-garment. In the course of a week the hymen was healed, but not united, the swelling subsided, but there remained a muco-purulent discharge for about two weeks.(*e*) A yet fuller illustration is presented by the case of a child under seven years of age ravished by an adult. It is reported by Dr. McKinlay.(*e*[1]) At the upper part of the cleft of the buttocks, behind and above the anus, the skin was besmeared with dried blood. The vagina was lacerated in various directions. One laceration extended down to the verge of the anus, laying bare the rectum, and others upwards and laterally. In the cavity produced by the laceration was some fecal matter which had escaped from the rectum through an opening an inch in length, and situated three-quarters of an inch from the verge of the anus. The child gradually recovered in spite of these frightful injuries.

If gonorrhœa or syphilis have been communicated, there may be, in addition to these marks of injury, an urethral discharge, chancres, condylomata, and, if sufficient time have elapsed, buboes and constitutional symptoms. We subjoin here a few cases, showing the appearances we may expect to find in children upon whom rape has been attempted.

§ 220. X., a man of leisure, was accused of having repeatedly misused three sisters, Agnes, aged 12, Clara, 11, and Antonia, 8. In all three the hymen was destroyed; in the two elder, the vaginal canal was uncommonly widened for their age, but not in the youngest. The opinion given was, therefore, that all three of the children had been deflowered, but that it was probable that the youngest had been masturbated with the finger. The evidence of the children, and some witnesses, gave all the details of this filthy transaction. Several more cases of an exactly similar character are given; we will, therefore, not repeat them. In the following case the whole proceeding was seen. Ottilia, aged ten years, still retained her hymen, although this was inflamed and relaxed. The vaginal entrance was dilated,

(*e*) Keller. Casper's Vierteljahrschrift. V. Band. 1 H. 1854.

(*e*[1]) Br. and For. Med.-Chir. Rev., Oct. 1859, p. 535. A very similar case, which ended fatally, is reported by Mr. Colles, Med. Times and Gaz., June, 1860, p. 560.

irritated, and very sensitive. An old man of not less than sixty-five years had, it was said, often abused the child, having first enticed her by the present of a silver penny. On the last occasion, when he was discovered, the act took place in a barn, and a witness observed it through the chinks of the wall. The opinion of Dr. Casper, founded merely upon the condition of the child, was that a complete penetration had not taken place. A journeyman baker, affected with gonorrhœa, was accused of rape upon a child seven years of age, of healthy constitution. The child, examined one month afterwards, was found to have the hymen uninjured, but had gonorrhœa, and the mucous membrane of the vaginal entrance in an inflamed condition. Hence the opinion was given that the condition of the child was due to an *attempted*, but not completed, coition by a man affected with gonorrhœa. Eight other similar cases are given. Another instructive case is the following. The girl was fourteen years of age. The labia majora were relaxed and inelastic, and did not cover the vaginal entrance as they do in the virgin state. The orifice of the vagina was dilated, particularly in the lower portion. The opening of the hymen, which was itself not destroyed, was unusually large, and the vaginal mucous membrane very red and inflamed. The hymen and clitoris were swollen, and there was also gonorrhœa. The defendant, a bookbinder, who was charged with having frequently had connection with the young girl, as well as others who visited his shop to buy writing materials, represented that he had merely used manipulations with his hand. Dr. Casper, in reply to the question put by the judge, stated that "it was improbable that the defendant had merely manipulated with the hand, since the dilation of the vagina was adverse to this opinion, and that masturbation merely could not induce so much inflammation, nor the urethral gonorrhœa which was present. Hence it was to be presumed that the defendant had at least *endeavored* to introduce his organ into the vagina." A case happened in London in 1858, and is related by Dr. Taylor,(*f*) of a girl of seven years, violated by a boy under seventeen years of age. There was complete de-

(*f*) Med. Jurisp., 6th ed. p. 697.

struction of the hymen, and slight laceration of the perineum but no other marks of violence. Very profuse bleeding had saturated the girl's clothing, but no trace of blood was found upon the boy's clothes or person; and it was inferred, therefore, that the bleeding was an after effect, and a result of oozing from small bloodvessels. Had not the proof of the crime been complete on other grounds, this circumstance would have rendered its commission by the accused improbable. Hascher (*f*[1]) relates a sickening case of a child eight months of age, violated by a boy eighteen years old. Upon examination there were found redness, swelling, and great tenderness of the labia minora and parts in the neighborhood of the urethra, with rupture of the hymen, frænum, and perineum, together with laceration of the posterior wall of the vagina.

§ 221. A case of genuine rape, with syphilitic infection, gave rise to an indictment against a journeymen hatter, who had abused his master's daughter in the most shameful manner. "The girl was only eight years of age, her private parts were very much dilated, and the mucous membrane, particularly at the entrance, very red and painful to the touch. The hymen was destroyed, and she had a virulent gonorrhœa." Dr. Casper gave his opinion, "that there was no room for doubt that an impure coition had taken place, and been really consummated." It was afterwards discovered that the accused was affected with gonorrhœa. But on account of his obstinate denial of the charge, and his endeavor to escape conviction by assigning other reasons for the infection, the judge proposed the question, if the common use of an *unclean chamber utensil* could possibly be the means of conveying the gonorrhœal disease. The answer was, that this was possible, but that such an origin of the disease could not properly be assumed in this case, on account of the destruction of the hymen, and the dilatation of the vaginal canal.

§ 222. There can be no doubt of the occasional transmission of gonorrhœa by other means than sexual intercourse; but it is important for the physician to keep in mind the fact, that, *in the case of children* at least, the presumption is entirely in

(*f*[1]) Oest. Zeitsch., xxxii. 33.

favor of the ordinary mode of infection, unless the signs of violence before enumerated do not exist. Dr. Ryan,(*g*) nevertheless, examined two children who were infected with gonorrhœa by using a sponge belonging to a servant girl who had the disease. Mr. Hamilton(*g*[1]) has published a case, in which a girl of six years of age was infected with syphilis by a boy of nineteen. The contagious matter was carried by the fingers. In Henke's Zeitschrift for 1850,(*h*) the details of a judicial examination of a somewhat similar case, where also the virus was conveyed by the finger, are given by Dr. Henrich, of Mayence.

§ 223. *Leucorrhœa* and gangrenous inflammation of the vulva are diseases which often arise *spontaneously* in young children, especially of the poorer class, and are due to bad diet, uncleanliness, scrofulous taint, and epidemic influences. In the minds of anxious relatives they may awaken suspicions of violence with intent to commit rape, and sometimes form the occasion for criminal prosecutions against innocent persons, for the sake of gain.

Leucorrhœa may be easily mistaken for gonorrhœa, for the discharge in the two diseases is nearly similar, and the local symptoms are so much alike as to render a positive opinion, in legal cases, rather hazardous. And yet, it is apparent, that the truth of the accusation may depend upon the determination of this difference alone. A case in point is furnished by Capuron.(*h*[1]) A little girl had a whitish and very acrid discharge from the vulva; the labia majora and mons veneris were red, swollen, and painful; there were several ulcers, with a secretion like that from the vagina. The parents regarded the affection as syphilitic, and believed that their child had been deflowered; but Capuron recognized the symptoms as belonging to a catarrhal affection which then prevailed in Paris, and by means of an appropriate regimen speedily effected a cure.

(*g*) Lond. Med. Gaz., vol. xlvii. p. 744.
(*g*[1]) Dublin Med. Press, vol. xx. No. 511, 1848.
(*h*) Erg. Heft 41.
(*h*[1]) Briand, Méd. Lég., 6ème éd. p. 77.

§ 224. According to Churchill,(*i*) "The commencement of the disease (infantile leucorrhœa) is marked by local uneasiness, itching, and scalding on making water; the mucous membrane is found inflamed and swollen, but for some time there is no discharge. * * At a more advanced stage there is observed a thin, colorless, mucous discharge, which slowly becomes more copious, thicker, and of a white or yellowish color. It is often of an acrid character, and causes a circle of inflammation, and sometimes of excoriation of the skin at the margin of the vulva. If the labia be separated, the mucous membrane will be found more vascular, and of a deeper color than usual; but in very few cases does this extend up the vagina. * * Under ordinary circumstances the disease is neither very tedious nor very obstinate, and, after running a certain course, it terminates in resolution."

§ 225. This description, with the exception of the last sentence, would answer equally well for gonorrhœa, the only reliable point of difference being the obstinacy and indefinite course of the latter.

In the case before referred to in Henke's Zeitschrift,(*j*) the virulent character of the discharge from the private parts was settled by the unmistakable gonorrhœal ophthalmia which the child brought on by touching her eyes with her soiled fingers. As the existence of gonorrhœa in a child, in the vast majority of cases, presupposes a criminal attempt, the proof of the former is merged in the proof of rape.

§ 226. Where, however, there is found *leucorrhœa*, *i. e.*, a simple mucous vaginal discharge, without any signs of violence, such as contusions, lacerations, dilatation of the orifice of the vagina, or injury of the adjoining parts, it may still be doubtful whether these marks of violence have not existed *previously* and disappeared, or whether it has had a spontaneous origin. This is a question which can only be answered from a knowledge of the time elapsed since the alleged injury. Where it results from mechanical violence, the discharge is at first mixed with blood, owing to the laceration and distension of the parts, and afterwards changes its character, becoming

(*i*) Dis. of Females, p. 35. (*j*) Erg. H., No. 41.

thick and yellow or thin and albuminous, according to the degree of inflammation and the influence of treatment, but is not as copious as where the disease is of spontaneous origin. But the leucorrhœa of children is *never bloody*, and, of course, no marks of mechanical distension or of laceration will be found at any period of the disease. In conclusion, it may be remarked that the leucorrhœa of children is quite a rare affection, so much so that no mention is made of it by some of the best authorities.

§ 227. Mr. Kesteven, of London, in the *Medical Gazette* for February 28, 1851, has recorded a case and attached thereto some practical and useful observations, from which the following is an extract. With reference to the physical indications of chastity, the medical opinion upon which, he says, may be divided into two classes, the public and private, the former, or the most frequent, "are those in which vaginal discharges in young children are mistaken by the parents or friends for the evidences of sexual intercourse by elder male persons having gonorrhœa or syphilis. Such cases have frequently occurred to myself, as they have to others; and, although now better understood by the profession than formerly, yet so strong is often the notion entertained by the public with regard to these cases, that it is not unfrequently extremely difficult to persuade parents that we have merely to deal with the results of ordinary disease, and not with those of violence. This notion, in several cases that have come under my notice, has unfortunately been *confirmed by hasty and erroneous opinions*, given by surgeons on the mere representation of the friends, without a proper examination having been made. *It is scarcely possible to speak too severely of such culpable and wilful ignorance.* Within the last few weeks, a child of nine years of age was brought to me, upon whom it was suspected that violence had been inflicted. A careful examination afforded evidence that the case was simply one of vaginitis. There was complete absence of any indication of violence, for, although it can scarcely be believed to be possible that sexual entrance into the vagina of an infant could, under any circumstances, be perpetrated; yet in the *attempt* much contusion of the young and delicate soft parts *must have ensued*, had it

been made. The parents were satisfied, and an individual unjustly suspected was forthwith released from so odious an imputation."

§ 228. "This disease," says Mr. Wilde, "although denominated, by Churchill and other modern writers upon the diseases of children, *leucorrhœa infantilis*, is better designated by the term *vaginitis*, for it is of a much more inflammatory character than either leucorrhœa or gonorrhœa—at least, as these two diseases present themselves in the adult female; and the discharge is much more profuse in the former, and much more purulent in the latter. This discharge proceeds principally from the vagina, although the external parts are generally bathed with it when we come to examine them, in the same way as the surface of the glans and the inside of the prepuce are usually covered with discharge in persons laboring under gonorrhœa, particularly where the foreskin is abundant. The redness and swelling of the labia, clitoris, and orifice of the vagina, are generally very great, and the hue of the former is somewhat purplish. Not being acquainted with the appearance of gonorrhœa in children under ten years of age, I cannot say whether the inflammatory symptoms are equal in appearance to those now described. The disease is, I believe, usually painless in the first instance; and it is only when excoriation has taken place from the irritation of the discharge, and that the urine passing over the abraded surface produces some degree of soreness, that any complaint is made. After some time, the period varying according to the virulence of the disease, and the state of cleanliness or the contrary in which the child is kept, the discharge excoriates the labia both on their external and internal surfaces, the fourchette, perineum, the margin of the anus, and all that portion of the integument of the thighs washed by the discharge, or which come in contact when moved one upon another. In fat children, the amount and extent of excoriation, which presents much the character of an eczematous eruption, is always greater than in those who are thin, or have been in any way wasted by previous ill health. The extent of this eruption is generally very well marked by a defined eczematous margin, extending from the pudendum, in a crescentic form, over the

thighs, and sometimes into the cleft of the nates. The character of this eruption, its *defined margin and extent*, may possibly, to a practised and unprejudiced eye, serve to distinguish this disease from the results either of violence or the mechanical irritation produced by the 'friction of the penis' between the thighs and external labia, as was endeavored to be proved by the crown in the late trials in Green Street. With respect to the discharge, it is generally of a very acrid nature, and is the cause of the excoriation and eruption upon the true skin; and, unless the disease has been discovered by accident in an earlier stage (such as by observation of the child's linen, or by the chance of some second party seeing the child), the two circumstances which first attract attention are, the difficulty of walking, or the pain in making water; but the date of the discovery varies from a few days to several weeks, according to the violence of the affection, or the care and attention bestowed by the mothers on their children. For the same reasons, the duration of the disease will vary from a fortnight to six weeks or two months. The age at which this vaginitis is most frequent is from four to ten, but it may appear earlier."

§ 229. The following notice of the disease is taken from a paper by Mr. Wilde, of Dublin, in the *Medical Times and Gazette*, September, 1853. This paper is entitled a "History of the recent Epidemic of Infantile Leucorrhœa, with an Account of Five Cases of alleged Felonious Assaults recently tried in Dublin." He says: "Considerable excitement has prevailed among all classes in Dublin during the last month, owing to the circumstance of no less than three cases of felonious assaults upon children under ten years of age having been brought forward by the crown at the late commission before the Chief Justices. * * * So impressed were those members of the profession in Dublin who were acquainted with the circumstances of the cases, that Professors Cusack, Beatty, and Geoghegan, and Drs. Churchill, Hughes, Hatchell, and Speedy, all came forward in court, gratuitously, to tender their evidence in what they considered the cause of truth, science, and humanity. Most practical physicians and surgeons, particularly those attached to public institutions, or who are well acquainted with

the diseases of the lower classes, know perfectly well that vaginal discharges, attended with inflammation of the external parts and an eczematous excoriation of the labia and the adjacent portion of the thighs, are not uncommon affections in girls aged from four or five to ten years." Mr. Wilde gives some curious and instructive details of the manner in which the charge of rape is got up in some of these cases. We will give one as a specimen. "The first one of these cases was that of Margaret Walsh, a child aged nine and a half years, in whom the disease presented a very virulent form when it was discovered by her stepmother, who, however, acknowledged that she had remarked her *walking lame for several weeks before*. There was considerable swelling and inflammation of the parts, and a most profuse purulent discharge. Upon the discovery of the disease by the stepmother, she at once accused the child of impropriety, and demanded the name of the person who had diseased her. Upon the child's denying all knowledge of such, she was forthwith 'soundly flogged,' and repetitions of the punishment promised until she confessed. It came out at the investigation that the mother took down the cross from the mantel-piece, and threatened her therewith—a very impressive mode of adjuration among the lower order of Irish. The neighboring women interfered, and by threats and promises endeavored to extort an acknowledgment, but without effect. Names of different persons were then suggested, but still the child said she could not remember any of them having offended her. Finally, an elder sister, who was present during one of these scenes of torture, reminded the child of an old pensioner named Barber (who resided in a distant part of the city, but who was formerly a neighbor of hers) having giving her a bit of sugar some months before, when they lived in his neighborhood. This she acknowledged, and then arose the accusation." The man was arrested, committed for trial, and sent to prison. The child stated that the prisoner took her into the open hall of a house adjoining his own, and entered into a detail of the transaction, which it is not necessary to quote. The medical evidence showed that the prisoner was not in any way diseased. "After a few words from Chief Justice Monahan, the jury at once acquitted the prisoner, who

was discharged, with, however, that suspicion against his character which, among persons of his own class, is not easily eradicated, while the unhappy child was stigmatized as a young prostitute, who had acquired gonorrhœa when little more than nine years of age!"(*g*)

(*g*) The following testimony by Mr. Cusack in one of Mr. Wilde's cases will further establish this point: "I examined the two children (Cosgrave, the prosecutrix, and Delmere); both were affected with the same complaint. They were filthy, and had a discharge from the pudendum. There was a crust surrounding the parts upon the true skin, which arose from the deposits from the discharge. This child had not the slightest mark of violence; and it was simply a case of a disease which all medical men have met with, and which is very common among children who are strumous, or badly cared for, or who have been in contact with each other. It is usually found in low life, but sometimes it is found in the better walks of life, where children have suffered from other complaints tending to weaken the constitution; and, I confess, I was horror-stricken at the time to hear that the prisoner at the bar was accused of such a crime. I was as convinced as I am of my existence that there was no violence offered or attempted upon this child, and that this was a common disease which is universally known to the profession. I conversed with Sir Astley Cooper on this very subject, and I entirely concur with what appears in his lectures, that numbers have suffered unjustly from such charges as the present being fabricated by the mothers of children." "This evidence," says Mr. Wilde, "which was given in a very decided and energetic manner, seemed to produce a considerable sensation in court; on which the Lord Chief Justice and the crown counsel cross examined the witness to a considerable extent, in order to show that, although there were no marks of violence, 'a penetration between the labia, accompanied with force, but not sufficient to do any injury to the surface,' might have occurred. In answer to this mode of putting the question, the witness said: 'If the penis was brought into contact with the parts, and a discharge ensued in consequence, it would certainly be a species of violence; but in the present case there was nothing to show me that any friction had taken place externally, or that any attempt had been made to do anything wrong. I am confident that the discharge was not, in any respect, the consequence of friction from the penis of any man. If there is violence, it would cause pain; but I could find not a trace of violence upon this child.' One would have thought that this evidence might have induced the crown to give up the case; but the lawyers only took it up the more determinedly, and, seeing that disease from natural causes was established, changed their hand, and endeavored to prove, by the subsequent witness, that, acknowledging the child was in the diseased state described at the time the crime was committed, still penetration between the labia, without what might be styled violence, but as a simple application of the parts, might have taken place—as the Chief Justice described it, the introduction of the parts, without force, and even to the 'hundredth part of an inch.'" Not-

§ 230. The gangrenous inflammation of the vulva, to which we have referred as giving rise to suspicion of rape, is a still rarer disease than leucorrhœa. It is due, generally, to some unknown epidemic influence, or occurs as the sequel of certain prostrating diseases—as measles, or scarlet and typhus fever. Velpeau says it commences with a grayish, red, or blackish vesicle, which ulcerates and then sinks below the level of the surrounding tissues, which assume a dusky red color. The mortification gradually extends on every side, and the labia become covered with a sanious and fetid discharge. The whole constitution suffers terribly, and without the prompt use of energetic remedies many children would perish. Mr. Kinder Wood, in 1825,(*h*) saw twelve cases of this disease, of which only two recovered. It is peculiar to children. We think that too much importance may be attached to it as rendering really difficult the question of rape. In all the cases of rape on children we have met with, we do not find one which presented any appearance which could be for a moment mistaken for this affection. The discrimination should not embarrass the physician, although the parents or relatives of the child may be so far misled as to attribute the disease to criminal violence.

§ 231. Cases have arisen, however, in which both physicians and jurists found the distinction difficult, yet more from the circumstances of the patient suggesting the suspicion of violence than from the characters of the disease itself. The earliest case is one often quoted from Percival.(*a*) "A girl four years of age was admitted into the Manchester Infirmary, on account of a mortification in the female organs, attended with great soreness and general depression of strength. She had been in bed with a boy, and there was reason to suspect that he had taken criminal liberties with her. The mortification increased, and the child died. The boy, therefore, was apprehended, and tried at the Lancaster Assizes, but was acquitted on sufficient evidence that several instances of a

withstanding the explicitness of the medical testimony in this case, the defendant got off only by proving an *alibi*.

(*h*) Medico-Chirurgical Transactions, vol. vii. p. 84.

(*a*) Medical Ethics, 1803, p. 103.

similar disease had appeared near the same period of time, in which there was no possibility of injury or guilt."

§ 232. The following more recent case presents very close analogies with the one just cited. In December, 1857, Amos Greenwood, aged twenty-two years, was tried at Liverpool for the murder of Mary Johnson, ten years of age. On a Thursday night the prisoner and deceased occupied the same bed in a room with other members of the family with which they resided, and then and there it was charged that the crime had been committed. The other inmates of the room heard no noise, and the girl made no complaint of suffering for three entire days, when her genitals were found to be sore and her thighs excoriated. On the fourth day she was seen by a surgeon, who pronounced her affection vaginitis. Becoming rapidly worse, her friends urged her to confess a criminal cause for her ailment, but she protested that she had nothing to divulge, until, being threatened that unless she did so she should be left to die, she declared that "her bed-fellow had been upon her, and hurt her very much." Mercury was then administered to her by an unlicensed practitioner, when sloughing and mortification set in, and proceeded with great rapidity. A surgeon next saw the patient, and discontinued the use of the mercury. The mortification extended, however, to the pubes and nates, including the urethra, labia, and vagina to the depth of two inches, and the child died thirteen days after the alleged attempted intercourse, and ten days from the first discovery that she was diseased. Greenwood was then arrested, and found to have venereal warts on his penis, and syphilitic sores beneath the prepuce. He was tried, convicted of manslaughter, and sentenced to penal servitude for life.

In this case the only direct testimony implicating the prisoner was that of the girl, from whom it was extorted by threats, after she had repeatedly denied that he had had anything to do with her.(*b*) Evidently, if copulation was at-

(*b*) "Frequently," says Casper, "have I heard very young but quick-witted children reveal, with the most perfect unconstraint, or even impudence, the whole course of the alleged affair and all its details in disgusting minuteness, so that it required but little penetration to perceive that they

tempted, it must have been so without violence, and without the infliction of pain, for the occupants of the adjoining bed heard no noise, and for three days afterwards the girl made no complaint, nor was her appearance observed to be different from usual. Her subsequent condition cannot, therefore, be attributed to an attempted violation. Is it with more probability attributable to a syphilitic infection derived from the prisoner? The existence of syphilitic sores beneath his prepuce would render his attempting coition improbable. But, admitting that they might have been insufficient to restrain his lust, is the existence of a syphilitic infection proved by an examination of the child's genital organs? These were first seen by a medical man upon the fourth day, who deposed that the girl had vaginitis, with ulcerated spots all over, from the size of a pea downwards. These sores had no resemblance in number or appearance to syphilitic ulcers, but, on the contrary, presented all the characters of aphthæ. The state of the parts certainly did not suggest to the medical man in attendance either that the child had syphilis, or that she was the victim of an attempted rape. It was not until an unlicensed practitioner had administered mercury that the symptoms which ended fatally were developed. Since, therefore, neither the nature nor the fatal issue of the child's disease could be distinctly traced to the prisoner, even on the supposition that there had been contact between the genital organs of the latter and those of the child, his conviction of manslaughter would seem to have been unjust. The person really guilty of the child's death was undoubtedly the unlicensed practitioner who gave her mercury, immediately after which the fatal symptoms began to be developed.(*c*)

§ 233. 2d. *Rape upon adult females.*—The question of the possibility of rape on an adult female is one that presents

were merely rehearsing a lesson which had been taught them; and it has seldom happened that the facts of the case did not confirm this belief."

(*c*) For the details of this case, and the discussion to which it gave rise, the reader is referred to Wilde, Dublin Quart. Journ., Feb. 1859, p. 51, and Med. Times and Gaz., May, 1859, pp. 518, 544; Kesteven, ibid., April, 1859, pp. 361, 417, 442.

considerable difficulty. The testimony of the female herself is naturally open to suspicion, since the cases of false accusations of rape are by no means rare. The majority of writers on medical jurisprudence maintain that when there is no disproportion between the age and strength of the parties, and the woman is awake, well, and conscious, a rape cannot be accomplished unless through threats against her life. It must be remembered, however, that there are few circumstances in which a woman can be placed where, from confusion, surprise, and terror, she is sooner deprived of the command of her will and the power of resistance. We believe that no general rule should govern our opinion on this question, but that it ought to be decided in each case according to the correspondence of the injury received with the woman's narrative and her character for modesty and veracity.

We subjoin the following case because it seems to disprove the accuracy of the general opinion, and bears strong internal evidence of credibility. On the 22d of March, 1849, a girl, twenty years of age, unmarried, and of virtuous character, returning home from an errand to a neighboring village, was met in the pathway through a wood by a young soldier, twenty-two years of age, with whom she had previously a slight acquaintance. He asked her to let him accompany her a little way on her road, to which she consented. After having gone a short distance, the soldier proposed to her to go with him into the bushes. He made an effort to force her, but did not succeed. He kept his arm around her body, however, and, seizing a favorable opportunity, suddenly raised her from the ground, and, with one hand confining her arms behind her back, threw her down, and with the other pulling up her clothes, prepared to effect his purpose. Upon her beseeching him to let her hands free, he did so, when she again made repeated efforts to get loose from him. He succeeded, however, in again securing her hands, and now lay with all his weight upon her, and endeavored with his knees to separate her limbs, but, with a last effort, she freed her hands and seized him by the privates. She would not let go until he promised to desist. He did so; when, as she attempted to rise, he caught her by the leg, and, throwing her back, finally succeeded by perseve-

rance in securing her hands and separating her limbs, after which he fully accomplished his purpose. All this was done without blows or any unnecessary violence. A witness who passed by after it was over, testified that he heard them quarrelling together, that the girl was crying, and the young man endeavoring to smooth her disordered dress. Upon her return home, she informed her mother, with many tears, of what had happened, upon which her father insisted upon her going to the parish priest, who lived about a mile distant, which journey she accomplished, though not without considerable pain and difficulty. Medical examination was had three days after the occurrence. The traces of a recently ruptured hymen were found, but other marks of violence were very trifling. There were no spots of blood upon her linen, but some traces bearing a resemblance to seminal spots were found. It further appeared that she was strong and healthy, and, it having been suggested to her that she had probably lost her breath in ascending the hill, and hence had been easily overpowered, she said no, she had entirely recovered her breath. The place was examined which she had indicated as the scene of the outrage, and evident marks of a struggle were found. The woman's statement was entirely unaffected by the cross-examination, while the prisoner contradicted himself repeatedly during the trial. He was sentenced to five years' imprisonment.(*i*)

§ 234. The following very analogous case is reported by Casper,(*i*[1]) who pronounces it one of the most instructive he had ever met with, because it appears to show that a strong, healthy, and fully grown maiden may be violated by a single man. On the 16th of January the accused enticed the girl, who was twenty-five years of age, into the park near Berlin, and, having vainly endeavored, owing to her struggles, to accomplish his purpose by forcing her against a tree, he seized her by the body and threw her upon the ground, where, being deprived, as she alleged, of all power of resistance, he flung her clothes over her head, and consummated his purpose. Nine days afterwards Casper examined her. She was modest

(*i*) Henke's Zeitschrift, Erg. Heft 41, pp. 21–44.

(*i*[1]) Gericht. Med., ii. 157.

and maidenly in her behavior, and, without any affectation, appeared to be very sad on account of her misfortune. The orifice of the vagina was found to be inflamed, and painful when touched or dilated, the hymen was entirely lacerated, and the swollen caruncles were very red. The fourchette was uninjured. Without any prompting, and only after some general questions in regard to her condition and feelings, she stated that for the last few days she had suffered less than at first in passing water and in going to stool. From these facts it was concluded that the woman had been ravished. At the trial it appeared in evidence that the policemen, who had been attracted by cries to the spot, found the ground frozen hard, and that the accused, even after his arrest, was in a state of satyriasis. He was condemned to four years' imprisonment.

§ 239. Although rape is a crime usually attempted without accomplices, this is not always the case. Dr. Taylor(*j*) refers to two instances of the sort. In both, the females were married women. In one it appears, that, while an accomplice held the head of the female, with her face downwards, between his thighs, the prisoner had forcible intercourse with the woman from behind, her limbs having been first widely separated. In the second case an accomplice held the woman down on a bed by the neck, while the prisoner separated her thighs, and thus had intercourse with her. She was examined nine hours afterwards by an experienced surgeon, and he found no mark or trace of violence or injury on or anywhere near her pudendum. There were bruises on her arms, neck, and legs, where she had been forcibly held down.

§ 240. In an elaborate study of rape contained in the *New York Medical Journal*, November, 1865, Dr. H. G. Storer cites the Bates case, which occurred in Boston, where a strumpet was forcibly violated by four men in succession against or without her consent. The defendants were convicted on the evidence of an eye-witness, and sentenced to five years' imprisonment.

In the same able and philosophic essay, which is worthy of careful perusal by all interested in the subject, Dr. Storer con-

(*j*) Medical Jurisprudence, 6th ed., p. 708.

tends that the punishment was disproportionate to the offence. The following points are made: (1) Rape is carnal knowledge without or against consent. (2) On the ground of the presumed innocence of the prisoner, the consent of the woman should always be assumed. (3) The position taken of late years, that the extent of penetration does not modify the nature of the offence, is regarded as unfair and contrary to common sense. Dr. S. also claims, what Casper so strenuously contends for, that each case should stand alone, and not be submitted to an all-including statute. It is laid down as a very general rule that complete entrance cannot be effected without manual assistance, and that the hands of the ravisher, if ravisher he be, are fully occupied in overcoming the resistance of the woman. This rule, it will be noticed, is at variance with the two cases just quoted. The four medical presumptions of intercourse are stated to be, (*a*) marks of violence on the genitals, or (*b*) other parts of the person of one or both parties, (*c*) spermatic or blood stains on one or both, and (*d*) the presence of a venereal disease. In considering the first two classes we must carefully satisfy ourselves if the injuries are old or recent, and whether their occurrence can be otherwise accounted for. Seminal stains on the clothes of the prisoner may have resulted from intercourse with another woman, or have had their origin in an erotic dream; while, if found upon the clothes or person of the woman, they may equally be the result of another coition—even if found within the vagina, they do not furnish certain evidence of completed rape, as the struggles of the woman may have caused the spermatic jet to take place at some distance, and the secretion in that case have only fallen within the ostium vaginæ. Of both spermatic and blood stains it may be safely said, that the weight of their evidence is much greater if found upon both parties. If, however, blood stains are found upon the genitals of a man who is suffering from neither piles nor hæmaturia, in the absence of an evident wound, the presumption is very strong that they were occasioned by carnal intercourse.

Finally, where the existence of a venereal disease is cited in proof of rape, it is important to establish the facts that the same form of disease exists in both parties, that it had not ex-

isted in the woman or child before the alleged crime, and that it made its appearance at such a time after the assault as to establish a connection as cause and effect. Dr. Storer says this period is from two to twelve days; we think that, in a case of true chancre, it should be extended to at least three weeks.

Emanating, as these dicta do, from so high an authority as that of the distinguished Boston professor, they are entitled to every consideration, and should be carefully borne in mind by the medical expert whose judgment is sought in these cases.

§ 241. Where a woman has been wrought into a *state of unconsciousness by intoxicating liquors* or by narcotic drugs, and when she is prevented by these means from making resistance, there can be no doubt that her chastity can be violated. The cases are quite numerous which attest this.(*j*[1])

§ 242. The question whether a *deep natural sleep* can render the female unaware of the sexual act is more difficult to decide. There are certainly some persons whose sleep is always exceedingly heavy, and who cannot be awakened by loud noise—such as thunder—by strong light, or by being rudely shaken. Long watching and fatigue, and heating drinks, are often followed by very profound sleep. It is not difficult to suppose that, in some rare instances, females, whose slumber may have been rendered unusually heavy from any of these causes, may be unconscious of sexual connection taking place at the time; and it must even be admitted that it may occasionally happen to virgins. Two cases illustrating this point are related by Montgomery,(*k*) the one borrowed from Gooch and the other communicated by Mr. Cusack. In both cases the females were unmarried, and regarded as virtuous, and both declared solemnly that they had no knowledge of the cause of their pregnancy. In each case the father of the child born confessed that he had had connection with the female, who was plunged in a deep sleep produced by excessive fatigue. Nor should such a statement be deemed incredible, when we remember that there are instances, quoted elsewhere, of children

(*j*[1]) See *post*, § 264, for the legal relations of this point.

(*k*) Signs of Pregnancy, p. 362.

born without the mother's consciousness, and that instances of a complete absence of sexual sensibility in the female are not uncommon. If, moreover, the act be perpetrated under the cover of darkness, upon a woman who has fallen asleep while awaiting her husband or lover, a certain degree of belief must be given to such an explanation. Yet, while allowing all due weight to these exceptional cases, their occurrence should not be lightly assumed, the presumption being certainly against it.(*a*) In the words of Valentin, "*non omnes dormiunt, qui clausos et conniventes habent oculos!*" A case has been subjected to judicial examination, in which a girl, eighteen years of age, declared herself pregnant by a professor of "animal magnetism." The state of insensibility called magnetic sleep, or hypnotism, is frequently marked by a total want of perception of impressions, such as usually occasion pain; and such was alleged to be the case in the instance referred to.(*b*) The opinion that the imputed crime is possible was expressed by the experts who were consulted, and was confirmed by that of Dévérgie.

§ 243. The proof of unconscious sexual connection is usually derived from the occurrence of pregnancy without a knowledge of its origin. We subjoin a few examples. Klein(*c*) reports a case where a stepfather violated and impregnated his daughter, of the age of eighteen, during her sleep. Zittmann(*d*) relates the case of a girl who was impregnated during her sleep, and was only conscious of having had an oppressive dream. Alberti(*l*) mentions the fact of a girl having been violated and rendered pregnant while in a state of stupor from a potion prepared from the seeds of *datura stramonium* (Jamestown weed). Osiander(*m*) relates that a young girl, only fifteen years of age, having fainted with terror at the sight of some drunken soldiers, was shamefully misused by them, and left bleeding and in an almost dying condition; she, however, recovered, but had got the venereal disease, and

(*a*) See *post*, § 458 et seq. (*b*) Abeille Méd., xv. 293.
(*c*) Kopp's Jahrb. der St. Arzneikunde, 10 Jahrg.
(*d*) Med. Forens. Cent., v. cas. 21.
(*l*) Syst. Jurisprud. Méd., tom. ii. p. 200. See *ante*, § 201.
(*m*) Handb. der Gerburtsh., § 286.

become pregnant. Klose (*n*) met with the case of a clergyman, who, while watching by the corpse of a young girl, gratified his lust upon her. Her death, however, was but a temporary suspension of animation, for she awoke and was pregnant.(*o*) It should, of course, be remembered that the truth of the statement relative to the commencement of the pregnancy is open to examination.

§ 244. Rape may be committed with comparative ease upon women *advanced in life.* Casper (*p*) relates a case in which a woman, sixty-eight years of age, decrepit and horribly pitted with the smallpox, was violated by a young fellow of twenty-seven.

§ 245. 3d. *Rape upon persons under the influence of ether or chloroform.*—A trial in this city has developed the importance of the question, how far the capacity of resistance on the part of the female, and her consciousness of the act, is abolished by the intoxicating and narcotic influence of ether and chloroform. With the exception of a somewhat similar case which occurred in Paris, we believe that this is the only one which has been made the subject of judicial investigation.

From the novelty and importance of the questions to which it has given rise, we have concluded to give here a full account of the history of the case, chiefly extracted from Dr. Hartshorne's vindication, and, in the note, some remarks of our own on the "psychical effects of ether inhalation," both of which are published in the Phil. Med. Exam. for Dec. 1854.

"A young lady of unimpeachable character, who has for some time been engaged to be married, is accompanied by her betrothed to the house of an eminent and highly respectable dentist, who had engaged to plug one of her teeth. They

(*n*) System der gericht. Physik, § 286.

(*o*) See also Rüttel, Henke's Zeitschrift, 1844, 264; Henke's Handbuch; Zeitschrift, 37 Bd. p. 290; Hartman, Canstatt's Jahresbericht für 1851, Bd. vii. p. 84. In this last case the woman could not only not be convinced of the existence of pregnancy, but was even unaware of the nature of her labor until she saw the child. See also Capuron, Méd. Lég., pp. 57, 84; Fodéré, Méd. Lég., tom. i. 497; Dict. de Méd., tom. xxi. pp. 358–9, also tom. x. p. 465; Dévergie, Méd. Lég., tom. i. p. 431; Gooch, Compend. of Midwifery, pp. 81, 82; Montgomery, Signs of Pregnancy, 2d ed., p. 360.

(*p*) Loc. cit., p. 26.

arrive about ten o'clock on a Friday morning. She enters the house, and after 'a few minutes' spent in awaiting the exit of two other ladies, she is ushered into the operating room or office. Here we will allow her to continue the narration in her own words.

"I went into the office; took off my bonnet, and Dr. B—— went to the washstand to wash his hands, and he asked me after the family; I took a seat on the operating chair; in a few minutes Dr. B—— told me one of the men wanted to speak to him, and he gave me a book to read and left the room; did not say what man; I supposed there were men there; he has a room in which the teeth are made; I believed those to be the men; Dr. B——'s family were out of town at that time; he said so, and the door was opened, and there was no furniture in the front room; I don't know how long Dr. B—— was absent; when he came back I was sitting in the operating chair; he went to the instrument case, and began with my tooth; the tooth was on the left side; he commenced operating on the tooth before he gave me ether; the operation was very painful; he said he would either put something in to destroy the nerve or give me ether, leaving the choice to me; I told him I'd prefer taking ether; I didn't learn what he proposed putting into the tooth; he gave me the ether on a small napkin, folded up; I felt very dizzy at first; I was cold and felt very numb; it increased upon me; I did not lose my consciousness of what was doing; I continued to breathe the ether; my eyes were closed; I closed them voluntarily; I did not try to open them for some time after; after he gave me the ether he did not, as I remember, operate on my tooth; he felt my pulse several times; put his hand on my arm under my sleeve, up my arm; I had a loose sleeve; he did it once; he put his hand on my breast under my dress; on the bosom; he put his hand on my person, under my dress; I have a distinct memory of that; I was not able to make any resistance or outcry; he went round before me and raised my clothes; I am perfectly distinct in my memory of that; I did not try to cry out; do not know if I was able; after he had raised my clothes, my feet were crossed, and he raised them and put one on each side of the stool; he then put his arm around me

under my clothes; he drew me down to the edge of the chair; I do not know what he did after that till I felt pain; he did enter my person; it was then that I felt the pain; I was not able to cry out or resist; I did not try; I don't know what was his position; my eyes were closed; I have no doubt that he did enter my person, and did give me pain; all this time I was conscious of everything that was going on; after this he left me and crossed the room to the washstand; I heard him pour out water into the basin; after he had been to the washstand and returned, I opened my eyes, and saw my clothes up; he did not see me; I have a clear recollection of seeing my clothes up; I closed my eyes immediately; he put down my clothes, and in a few minutes he was at the side of the chair, and lifted me up into the seat; I was just to the edge of the seat; it was a large dentist chair; in a few minutes he told me he'd have to take the tooth out; that was the first remark he made, except the first, when he asked me if I was getting sleepy; at the time he entered my person I did not feel his person against me; pain I distinctly felt; when he spoke about taking out the tooth, I asked him why; he said they were both decayed, and he could not save them both; I told him I was afraid it would pain me, and he said he would not let it; he then gave me more ether, and extracted the tooth; I was on the left side; when he extracted the tooth it was painful; I screamed then; he then assisted me to rise, and led me to the rocking-chair; I felt a little dizzy when he led me to the rocking-chair; he then went out of the room, and in a few minutes came up with a lady; I have not seen her since; he asked me if I would be introduced to her; I believe I said no; he did not introduce me then; I heard him tell the lady he'd always been our dentist, and that we never had been to any other; he said my teeth were very good; he said I had taken ether, when the tooth was extracted; I think she said something about hearing me scream; he said yes, ether had not much effect on me, I was either nervous or for some cause; in a little while I got up, and he introduced me to the lady; I think it was Mrs. P——; I made several remarks, but I don't know what they were; I then put on my bonnet, and Dr. B—— followed me down stairs; the lady was left up stairs; he came to the door,

and I wanted to stop an omnibus; he asked me how far I was going, and I told him to Third Street and Lombard; he told me I had better walk; he said he thought that I had some of the ether in me, and the walking would do me good; I walked down Walnut to Sixth, and did not get into an omnibus; I did not reproach Dr. B—— at the house; I was afraid; I stopped in C—— ice cream saloon, at Sixth below Prune; I got ice cream; I went then along Sixth Street to Spruce, and down to Third and Lombard Street; I was going to see a young woman that sent for me; I did see her; don't recollect how long I was there; when I left I came up to Mr. T——'s at Chestnut Street, near Fifth; I was very intimate with Mr. and Mrs. T——; I met Mr. M—— on the way up, near Sixth and Chestnut Street; he joined me and spoke to me; did not accompany me to Mr. T——'s; did not meet any but those I have named; I reached Mrs. T——'s at one o'clock; they had not been to dinner; I first mentioned to Mrs. T—— what had occurred at Dr. B——'s, the same day after tea; that afternoon I was taken unwell; it was the usual time; the door of the dentistry room at Dr. B——'s was shut; there are two doors in the room; the one leading to the entry door was closed; Dr. B—— said that he closed the door because the smell of ether would go over the house; the door was shut before he gave me the ether; the chair is one that leans backwards.

§ 246. "*Cross-examined.*—Dr. B—— was the dentist of our family; don't remember the number of years; it was from the time of my early youth; he attended all the members of the family so far as they required it; I went to him with the approval of my parents; he generally behaved like a gentleman; I did not know his family; don't know how many years I have been his patient; when I called with Miss Thr—— it was to get my tooth plugged; on several times before I had taken ether; I requested it to be given; I don't remember of his persuading me from it; the tooth was not plugged when I was there with Miss Thr——; the following Thursday was appointed for future operation; I did not go on Thursday; Mr. Thr—— had the appointment made; I believe it was on Wednesday morning; I received a letter from him to that effect; I requested

him to go in with me; he was there when the woman came to the door; I was shown into the front parlor; it was the usual place; it was but a few minutes before the ladies came down; Mr. B—— came down before; he said he had several young ladies up stairs and would be down in a few minutes; I went into the usual operating room up stairs; the door opening into the front room was opened at the time; it was the back room of the main building I was in; the workshop is in the second story back building; don't know how far from the room in which I was; it is not upon the same level; it is lower; I don't know if I could see into the windows of the workshop from the window of the room in which I sat; when Mr. B—— went to see the workmen he gave me one of the monthly magazines; while I was in the room nobody came to the door that I saw or heard; don't know of the doctor leaving that room; did not see any women there except Mrs. P—— and the Miss H——; the windows were closed in the room, *i. e.*, the sashes were down; no change was made in their condition while I was there; don't remember any one calling as a sitter while I was there, and Dr. B——'s speaking of it; I did not know of Mrs. P——'s being in that house before she was brought up stairs; I don't remember speaking to Dr. B—— of the fan and requesting him to give me ether; from the time I closed my eyes after the ether had been taken, I did not open them until after the liberties had been taken; I did not open my eyes until he returned from the washstand; what I have described is from what I have heard and did not see; I did not see any part of his person exposed, nor the application of any part of his person to me; don't know, except from the pain, what part of his person was applied to me; he passed his hand up my arm immediately after he had felt my pulse; after the ether was administered a second time no liberties were taken; I judge that he did not see me when I opened my eyes, because he was not in front of me; when he told me he would have to pull the tooth, I asked him why; the reason why I agreed to take the ether a second time was, because I was afraid; I was not afraid to have my tooth taken out, or to be operated upon further; I don't know if either of my teeth were prepared for plugging; I suppose he touched the tooth

he took out; that gave me pain; I told him I'd had the tooth-ache; another appointment was made for Monday at two o'clock; I asked him when I was to come again to have that finished, and he said at that time; I asked him that when I was going and had my things on; he booked it at my instance; I don't know if it was before Mrs. P—— came in or not; Dr. B—— did not say there was a sitter waiting for the chair; I did not see any one call to inform him of a sitter; I never notice such small things as that; don't know how long after he had finished the tooth that he went down for Mrs. P——; I did not remain more than five minutes; Mrs. P—— said she came from the country and came to have her teeth attended to; Dr. B—— followed me down stairs; that is his custom, not only with me but with other ladies; when at the door I did not manifest any displeasure with him; I told the doctor I wanted an omnibus; I believe I bid him good-bye; soon after I got out of the door of the second story, I told him to say good-bye to Mrs. P—— for me, as I had forgotten it; the chair I sat in was the one I had always used; there was but one operating chair in the room; Dr. B—— asked me if I ever rode on horseback; I said yes, sometimes; he said, ride over and see us; I replied, perhaps I will; that was up stairs; on the way down to C——'s I did not meet any one I knew; I did not meet any one on my way to Third and Lombard Street; I told Dr. B—— I was going on an errand to Third and Lombard Streets; it was an errand for my sister in respect to some articles of dress; I did not speak to her of the treatment I received; did not sit down very long; when I left Dr. B——'s I think it was a few minutes before or after twelve o'clock; I don't remember which; I don't know how long I was at C——'s; not long; reached Mrs. T——'s a little after one o'clock; Mr. M'K——, whom I met, asked after the family; I did not tell him where I had been; he only walked with me a short distance; I did not complain of any pain to Dr. B——, except the pain of my teeth; I don't remember how long the first application of the ether lasted; after I took it I felt no pain in my teeth; cannot describe the effect of the ether, except that it made me dizzy; I did not see the doctor at all during the operation of the first ether; I felt his breath

as well as felt pain; the pain did not continue long; I had no other indication of the approach of my monthly discharge but that day; it occurred in the evening; I did not examine my person in the interval; nobody examined it between those times; I did not examine my garments; my mother did on Sunday afternoon; nobody before; those garments don't remain now as they did then; they are washed; I don't know when; I made the communication to Mrs. T—— after tea on Friday evening; I told Mrs. T—— before I became unwell; I gave evidence before the Mayor; don't know if the garment was washed before that; it was not washed till I went out home; during the time I was at Mrs. T——'s till I was taken unwell, no physician was sent for; I was never examined by a physician; on the afternoon of Friday I was out riding with Mr. and Mrs. T——; we set out about six; I do not know where we went; somewhere on the plank road; it was some time after I returned that I felt unwell; spoke to Mrs. T—— on the subject after tea; we had tea as soon as we came home from riding; Mrs. T—— told Mr. T——, and Mr. Thr—— asked me a single question about it; I answered it; and that was all I said; it was before I felt unwell that I told Mr. Thr—— about it; he remained as long as I did, and went to my grandmother's with me; on the next day I went out to the depot, but did not go to my father's; Mr. Thr—— accompanied me to the depot; I met Mr. and Mrs. T—— out there; I did not see my father or mother; I saw my father on Monday morning in Fifth Street; at the time he left to go down stairs, I did not see if he opened the door or not; I was sitting with my back to the door; I don't know why I refused to be introduced to the lady when he first asked me the question; my father and Mr. Thr—— accompanied me to the Mayor; Mr. and Mrs. T—— and my two uncles were there; my father was there before I was.

§ 247. "*Re-examined.*—I said that Dr. B—— generally used me like a gentleman; he said a year ago that he should like me for his second wife; he had a good many children, but they should not trouble me, as he would get nurses for them; I spoke of it at home to my mother and sisters; after the doctor took me out of the chair after the operation, all that I

said was in answer to questions by him, or to remarks; the reason why I did make another appointment with him (Dr. B——) was that I did not want him to know that I knew anything of his conduct; I had not concluded what course to pursue."

We leave the comments upon the legal proof of penetration or of rape in this case to our colleague; the question as to the capability of evidence on the part of a female, relative to what has occurred during the period of etherization, and the possibility of resistance under such circumstances, may, we hope, receive an answer in the subjoined remarks.(*q*)

(*q*) There is a striking analogy between the effects of ether and those of alcohol; the chief difference between them being in the more rapid and complete insensibility produced by the former, and in the more evanescent character of the intoxication. There is a period of excitement, of stupor, and of recovery, and the phenomena observed in different individuals vary according to their temperament and habits. In general, the state of excitement in etherized patients is short, and verges rapidly into that of unconsciousness and insensibility to pain. The vapors of ether seem literally to ascend and diffuse themselves through the brain, and to permeate every portion of the body; the patient has a sense of fulness and warmth; the whole body feels lighter and seems to spurn the earth; the sense of hearing becomes confused, the sight dim, and the touch benumbed. External objects lose themselves in a confused mist, which appears to swell their proportions and contort their shape; the muscles become relaxed, and the patient sinks lethargic and unconscious into a profound sleep.

During the transition into a stage of entire insensibility, he responds to external impressions only in an automatic manner: the most painful incisions, if felt at all, seem to him like the marking out of lines upon the skin, and the extraction of deep-seated tumors like the crackling of hair between the fingers. All his movements are instinctive; an expression of suffering is often depicted upon the face; the hands are raised against the operator as he attempts to draw a tooth, and, when spoken to, he answers in a vague and dreamy manner. The recovery from this condition, or from a more advanced stage, is apparently sudden, but, as in the waking from profound natural sleep, the perceptions are for a few moments confused, even while the person thinks himself fully awake and appears to be so.

Dr. Forbes has well described the *psychical* state under the influence of ether. "Generally speaking," he says, "the sense of external impressions becomes at first confused, then dull, then false, with optical spectra or auditory illusions, general mental confusion, and then a state of dreaming or utter oblivion. In the majority of cases, the mind is busy in dreaming, the dreams being generally of an active kind, often agreeable, sometimes the reverse, occasionally most singular, and frequently a great deal is transacted

§ 248. Finally, although a woman may be of age and strength sufficient for effectual resistance, she may be naturally

in the few short moments of this singular trance. Many of the patients who have undergone the most dreadful operations, such as amputation of one or both thighs or arms, extraction of stone, excision of bones, extirpation of the mamma, have readily detailed to us, and most with wondering thankfulness, the dreams with which, and with which alone, they were occupied during the operations. The character of the dreams seemed to be influenced, as in ordinary cases, by various causes, immediate or remote, present or past, relating to events or flowing from temperament." * * * * * "A good many seemed to fancy themselves on the railway, amid its whirl and noise and smoke; some young men were hunting, others riding on coaches; the boys were happy at their sports, in the open fields or the filthy lane; the worn Londoner was in his old haunts carousing with his fellows; and our merry friend, Paddy, of the London Hospital, was again at his fair, wielding his shilela in defence of his friends. Others of milder mood, and especially some of the women patients from the country, felt themselves suddenly transported from the great city and crowded hospital-ward, to their old uiet home in the distant village, happy once more with their mothers and brotners and sisters. As with the dying gladiator of the poet, the thoughts of these poor people—

'Were with their heart, and that was far away.'

Some seemed transported to a less definite, but still happy region, which they vaguely indicated by saying they were in heaven; while others had still odder and warmer visions which need not be particularized." (Brit. and For. Med.-Chir. Review, April, 1843.) It is with this psychical condition that we have now chiefly to do.

What then is the influence of the inhalation of ether upon the *perceptions?* It undoubtedly cuts off, more or less quickly, the life of relation, and severs us from the external world. The lapse into unconsciousness is gradual but rapid, and does not admit of division into distinct intervals. The sensation of pain is often lost before outward consciousness has become totally obscured. Indeed, instances are related in which the patient has himself looked on as a calm spectator of the painless mutilation of his body. A patient of Prof. Pitha, being put under the influence of chloroform, at once fancied himself in his beloved Italy, and gave full vent to his expressions of delight; he raised himself up during the operation for the liberation of a hernia, and watched it with great interest—answering to the question whether he felt any pain, "*Si, io sento l'incisione, ma non sento dolori.*" (Prager Vierteljahrschrift, 1848, 3 Bd.) Such cases are rare, and it is important that we should not be misled by this apparent outward consciousness. In the instance just cited, the perception was by no means unperverted; since, although the patient replied correctly when questioned, he imagined himself in a distant country. During an extremely painful operation performed by Velpeau upon a young girl, she raised herself into a sitting position as if to observe it.

so simple-minded, or so ignorant of the nature and consequences of the sexual act, as to offer the greatest facilities to

She said afterwards that she supposed herself seated at a dinner table. (Rev. Méd., 1847.) In the greater number of cases, however, the perceptions are greatly perverted—illusions being sometimes suggested by the scene actually passing, and at others arising without being prompted by the external perceptions. Some cases, illustrating this fact, we quote from the interesting work of Dr. Flagg. (Ether and Chloroform, etc., by J. F. B. Flagg, M.D., Surgeon Dentist, etc. Philadelphia: Lindsay & Blakiston, 1851.)

After an operation performed on the forehead of Mr. T——, a dentist of this city, he said that, although his eyes were shut, he saw every cut of the knife. "He saw the shape of the wound upon the forehead; and, what was better than all, this cutting appeared to him to be done upon somebody else." A lady dreamed that she was at Cape May, and was going into the surf, and that while in the water she was attacked by a shark, which held her fast, but without pain, until the company present extracted his teeth and liberated her. A little girl, the extraction of whose tooth made a report like the drawing of a cork, sprang out of the chair, "crouched upon the floor, and looked up anxiously at me and inquired if anybody was killed." She supposed she was travelling upon a locomotive engine, which had been blown up and thrown her into the air. A boy fancied himself in a cotton-mill; an Irish woman dreamed that she had been home, and seen her friends engaged in spinning; and others dreamed that they were in railway cars or shipwrecked: the dream in some cases being suggested intentionally by the dentist, or being due to accidental noises. A countless number of cases might be adduced to show that patients under the influence of ether have been completely ignorant of all that passed around them while in this condition, and have been surprised to find, upon their recovery, that they have undergone the most severe surgical operations. But this fact is too familiar to need illustration. It is only important to observe that during this state of utter oblivion the mind is often busily engaged upon its own inward perceptions, which may or may not be pertinent to the actual position of the patient. These perceptions shape themselves into dreams entirely similar to those of natural sleep, being grotesque and improbable, cheerful or painful, according to the temperament, occupation, and habitual mode of thought of the individual.

One of the most extraordinary effects of the inhalation of ether is its effects upon the *emotions*. Thus some persons are seized with the most irrepressible mirth, while others seem to sink under the weight of despondency. Women are especially liable to these effects. Hysterical paroxysms are by no means a rare accompaniment of ether inhalation. In others the erotic propensities are strangely excited. Siebold relates the case of a woman whom he rendered insensible by ether. Upon regaining her consciousness she appeared to be in a highly excited state, and was loud in her praises of the delightful condition in which she had been; her eyes sparkled, and a certain erotic excitation was very observable. (Ueber die Anwendung der Schwefel-Äther-Dämpfe in der Geburtshülfe, Göttingen, 1847.) Pitha observed excitement

any one who may have the knavery to take advantage of her. A case in point may be found in the second edition of Whar-

of the sexual feelings in two cases, one of a woman and the other of a man, upon whom he operated. (Prager Vierteljahrschrift, 1847, Bd. 3.) "In one of these cases, observed by M. Dubois, the woman drew an attendant towards her to kiss, as she was lapsing into insensibility, and this woman afterwards confessed to dreaming of coitus with her husband while she lay etherized. In ungravid women, rendered insensible for the performance of surgical operations, erotic gesticulations have occasionally been observed; and in one case, in which enlarged nymphæ were removed, the woman went unconsciously through the movements attendant on the sexual orgasm, in the presence of numerous bystanders." (A Lecture on the Utility and Safety of the Inhalation of Ether in Obstetric Practice, by W. Tyler Smith, M.B., Lancet, March 27, 1841; also in Bulletin de l'Académie, vol. xii. p. 406.) We doubt not that other cases might be brought forward to illustrate this fact, but the paucity of published reports of such a nature will be readily attributed to the natural unwillingness of patients to disclose painful illusions of this kind, and of physicians to make them known. In further illustration of the disordered condition of the mind under the influence of ether, the following case may be cited. A female rendered insensible by ether, after some unintelligible phrases, related some most circumstantial details of her private life. This involuntary confidence, which might have been followed by serious consequences had it taken place anywhere but in a hospital, was discovered afterwards to have been perfectly true. (Ann. Medico-Psycholog., vol. xii. p. 376.)

In the above observations it may very plainly be seen that the *will* no longer exercises its control over the mental operations. The thoughts run headlong upon their accustomed track, or in any direction in which they may have been impelled by fortuitous impressions made upon the nerves of general or special sensation. There is no power to restrain them, and, while the dream is a pleasant one, no desire to do so. Often, however, the illusions are painful or disagreeable, and in such cases the individual may make an effort to escape from or to repel them. Movements under these circumstances, therefore, imply an exercise of the will. This resistance is almost always to illusions proceeding from external impressions. We have already referred to the frequent occurrence of instinctive struggles against the hand of the operator, while the impression, as afterwards related, has been upon the mind of the patient that he was playing a part in some very different scene. Thus the little girl whose case is before referred to, and who fancied, when her tooth was drawn, that she was blown from a locomotive, *sprang* from her chair upon the floor while still unconscious.

Another young lady, mentioned by Dr. Flagg, when the forceps was placed upon the tooth, cried out, "Stop pulling! stop pulling!" The tooth was nevertheless extracted. "She *rose* from the chair in much excitement, and would have fallen to the floor, but I caught and sustained her for a moment, when the ether instantly passed off." This young lady dreamed that she was

ton's Criminal Law, p. 439. Here a girl allowed a medical man to have connection with her, under the belief that this

in danger of shipwreck, and, seeing the rocks and breakers ahead, cried out to the man at the wheel, with all her strength, to "stop pulling." In another instance, a lady, while under the influence of ether, resisted the attempt to extract her tooth. She *got up* from the chair, seeming much offended, and took her seat in another part of the room. When the effect of the ether passed off, which was in about a minute, she was much astonished at finding herself so remote from the position she occupied when she fell asleep. (Flagg, p. 102.)

The following singular instance may be appropriate in this place. A young man having been sufficiently etherized, the dentist prepared to extract a tooth. In a moment he dashed the instrument from his mouth, *left the chair*, and, striding about the room, demanded what they meant to do with him. In a few moments the effect of the ether passed off. Being again put under its influence, the same scene was enacted, with even greater violence, and he endeavored to jump out of the window. When he regained his memory, he related that he imagined himself surrounded by a great number of enemies, one of whom endeavored to drive a nail into his mouth, and, being unable to struggle with them, he had sought safety in flight. (Union Méd., Sept. 1857.)

Mr. Gerdy, in trying the effect of ether upon himself, with the object of observing closely its successive phenomena, found that, with the exception of the vibratory and benumbed sensation which rendered the sense of touch and of pain obtuse, and the noise in the ears which dulled the sense of hearing, his intelligence was clear, his attention active, and his *will* so firm that he willed to walk, and he did walk, in order to observe the effect upon his locomotion. He found that his step was only less sure than usual, and was similar to the gait of an intoxicated person. (Bulletin de l'Académie, vol. xii. p. 304.)

We have cited these examples, out of many of a similar nature, for the purpose of showing that the power of the will over muscular movement is not entirely abolished in etherization. It is true that the muscles are speedily relaxed, but they are not paralyzed. The patient may exercise his will, or he may not; if he does, it is to escape from danger, real or imaginary, but which has always to him the form of reality. If he does not make any movement, the fact is due either to the pleasurable or trivial character of his mental perceptions, or to the temporary but complete unconsciousness and insensibility in which he is plunged. That advanced stage of etherization in which perfect narcotism is produced is, in reference to the present question, of considerable importance; for, if the power of resistance is then lost, so also is the consciousness of a real motive for it. To be more explicit, if an outrage be perpetrated upon a woman lying wholly helpless and unconscious, she cannot be aware of the liberties which are being taken with her person, and will not, therefore, make any opposition to them. She cannot, moreover, afterwards describe, with elaborate detail, the manner and particulars of the assault, and yet have been incapable of withdrawing from or

was medical treatment. Dr. Fleischmann (*r*) relates a case which occurred in his own practice. He was consulted by the

repelling it. If her muscles and voice have been paralyzed, so also has her outward consciousness.

The recollection of what has passed during this stage of etherization is wholly confined to the inward mental preceptions—to the dreams, which have all the vividness of real occurrences. In the language of Dr. Forbes, "the old story of the magician in the Arabian tales seems more than realized; the ether being like the tub of water, one moment's dip of the head into which produced a life-long vision in the dreamer's mind." It is possible that these dreams may be so vividly impressed upon the mind that they may have afterwards to the patient all the force of real occurrences, and that he may refuse to believe that they have been merely the disordered perceptions of his own brain. In general, these dreams being of a trivial or of a pleasing character, it is not surprising that the patient should acquiesce in the belief of their unreal nature, but the case is very readily conceivable in which the hallucination may have been so distinct and, at the same time, of so repulsive a character as to leave an indelible impression upon the mind and a conviction of its reality. Authentic published evidence of this fact is indeed wanting, and we purposely forbear, for reasons which cannot fail to be apparent to our readers, to refer to that which was said to have been offered in the recent trial, as well as to that which we possess from private sources.

The following cautious remarks of M. Bayard are not without significance: "If," he says, "in some cases, individuals have rendered an exact report of what has passed around them, or of the liberties which have been taken with them while under the influence of ether and chloroform, it must not be forgotten that very frequently they have dreams, hallucinations, and illusions which they relate with a conviction of their actual reality. Experts should therefore receive with extreme circumspection declarations made before them under these circumstances, and, both in their written reports and verbal depositions, should endeavor to enlighten magistrate and jury upon the relative value and credibility of such revelations." (Appréciation Médico-légale de l'Action de l'Ether et du Chloroforme. Ann. d'Hygiène, vol. xiii. p. 201.) It appears to us, from what has now been stated, that the following positions may be assumed as correct:—

1st. That the consciousness or perception of external objects and impressions is impaired in the early and lost in the final stage of etherization.

2d. That during the time the mind remains susceptible to external impressions at all, these reach it in a feeble or perverted manner.

3d. That the emotions, and especially those of an erotic character, are excited by the inhalation of ether.

4th. That voluntary muscular movement is not paralyzed until the state of

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(*r*) Henke's Zeitschrift, 1839, p. 294.

parents concerning their daughter, a girl seventeen years of age. She had been brought up in a very secluded manner,

perfect narcotism is produced, at which time, however, all outward consciousness is extinct.

5th. That the memory of what has passed during the state of etherization is either of events wholly unreal, or of real occurrences perverted from their actual nature.

6th. That there is reason to believe that the impressions left by the dreams occasioned by ether may remain permanently fixed in the memory with all the vividness of real events.

[Since these remarks were written, there has been much evidence published, given at meetings of the dentists in New York and Baltimore, which fully confirms what has been now stated, and places the whole of the positions assumed by us beyond the possibility of a doubt as to their accuracy. We have only to add that the dentist, Dr. B., was found *guilty* by the jury, and sentenced by the judge to four years and six months imprisonment. We sincerely believe that a great wrong *may* here have been inflicted upon an innocent man, which can only be compensated by the probability that the fallible nature of the evidence upon which he was convicted will hereafter render it difficult to sustain an accusation upon similar proof.] To complete this history, it may be added that Dr. B. subsequently received a pardon from the Executive of the State, in consequence of the large mass of testimony, presented by physicians and dentists, going to prove the entire possibility that the whole accusation grew out of a hallucination such as ether is competent to produce. A case closely resembling that of Dr. B., in the text, occurred at Montreal in 1858. A dentist was indicted for attempting to commit a rape upon one of his patients under the influence of chloroform. At the trial, a witness testified that his wife was under the strongest impression that she had been violated by the prisoner while under the influence of chloroform; yet her husband was present during the whole time she was unconscious. The verdict of the jury was "guilty of an attempt to commit a rape, with a recommendation to mercy"! (Boston Med. and Surg. Journ., Nov. 1858, p. 287. For a similar case in Ohio, in 1860, see *post*, § 266.)

The medical editor of 1873 cannot refrain from adding a few comments upon this oft-cited case. The views expressed in previous editions of the very dangerous character of the precedent established by the decision in this case have been generally indorsed by the medical profession, and we hardly think a similar result would be again reached. The most grave defect in the chain of evidence presented by the prosecution was the absence of any examination to prove recent defloration of the plaintiff. The fact also that the complainant thought that she had opened her eyes while in the anæsthetic state and immediately closed them, goes very far to prove that the whole occurrence was a delusion, as opening and closing the eyes requires a voluntary effort of which an etherized person would be incapable—and it is abundantly shown in the preceding note how common it is for patients under the influence of

and was both weak-minded and wholly inexperienced. Her monthly periods were suppressed, and a certain train of symptoms set in which awakened in his mind suspicions of pregnancy. The mother indignantly repelled this idea. He still, however, continued his attendance, and prescribed various remedies, without any avail. At last the violence of her pains compelled the girl to take to her bed. Here she lay for a short time in a half-unconscious condition, but suddenly she gave a loud cry, threw aside the cover, and displayed, to the astonishment of all, a living child, just born, lying between her thighs. In answer to her mother's anxious inquiries, she declared, with the greatest candor and simplicity, that she had never slept with a man, and knew nothing more except that a long while before, her cousin N——, on a Sunday, when her parents were not at home, had played with her, and caressed her a great deal, and then, she said, "*er hat mir auf dem sofa recht schön gethan.*"(*s*)

§ 249. 4th. *Physical evidences of rape.*—Very little need be said of the *physical signs* of rape upon the adult female. Where the violence employed has been great, it will be found generally that it has been expended in overcoming the resistance of the woman before an actual penetration has been attempted. Hence, although bruises may be found upon the thighs and knees, and on other parts of the body, they are certainly inconclusive of rape, without some marks of injury can be found upon the private parts also. We of course refer only to the medical evidence, as it is plain that the fact of rape having been attempted may be established by other testimony. We have already alluded to the fact that a medical examination in cases of rape is seldom had early enough to secure any useful data; this is especially vexatious in the case of adults, in whom, of course, the traces of sexual connection will soon disappear.

The only valuable indications are deduced from *the condition of the hymen* and *the traces of blood and semen.*

an anæsthetic to have vivid activity of brain present, while hardly ever is the dream similar to the real acts transpiring.

(*s*) We know of no equivalent English phrase by which to translate this remark.

§ 250. (1) *Condition of the hymen.*—This comes under consideration only, of course, where the female is represented as having been a virgin. Indeed, the hymen is looked upon as the infallible sign of virginity. A brief mention of the various circumstances which affect its value as a test of virginity will show under what limitations evidence from it may be received.

§ 251. (*a*) *It is not always destroyed by the first connection.*—This is abundantly proved by the numerous instances in which it has been preserved entire until the occurrence of parturition; a fact which proves also that it is not an insuperable obstacle to impregnation.(*t*) The accoucheur has sometimes been obliged to incise it, in order to allow the delivery of the child; in some rare cases, on the other hand, it has become gradually dilated and extended in such a manner as to permit the child to pass without its being ruptured. Maschka refers to the case of a girl, eighteen years of age, whose vagina was notably enlarged by coition, although the hymen was uninjured. This membrane was crescentic, thick, and fleshy, but as elastic as India rubber.(*t*[1])

In *Henke's Zeitsch.* vol. xl. p. 173, is related with detail a case in which, after four years' marriage, the hymen was found to be still uninjured, being thick and parchment-like, although yielding and presenting an opening about the size of a pea. The pair fulfilled their marital duties, imperfectly, of course, yet nevertheless the lady became pregnant, and was confined prematurely in the sixth month. Dr. Montgomery says: "The existence of the hymen at the time of labor has been observed by Ambrose Paré, Willis, Ruysch, Nægelé, Baudelocque, Mauriceau, and many others; the cases related by the last two

(*t*) Canstatt's Jahresbericht für 1851. Credé, Bd. iv.; Kluge, Med. Preuss. Vereinzeitschrift, 1835, No. 22; Siebold—Siebold's Journal, Bd. xii. S. 210; Scanton, Lancet, Mar. 8, 1851; Schmittmüller, Henke's Zeitsch. Bd. xli. S. 172; Möller, Ibid. Erg. Heft. No. 32, 1843; Schildbach, Ibid. Bd. xl. p. 210; Ribke, Casper's Wochenschrift, 1835, No. 2, S. 16; Streeker, Henke's Zeitschrift, Bd. xxxix. S. 218; Himmer, Neue Zeitsch. für Geburtskunde, Bd. iv. H. 1 S. 3; Montgomery, Signs of Pregnancy, etc., 2d ed., p. 366 et seq., where numerous other references will be found. See also a recent case in Casper's Vierteljahrschrift, 1855, p. 93.

(*t*[1]) Prager Vierteljahrs., lxvi. 69.

are particularly remarkable. Dr. Blundell met with four cases of impregnation in which the hymen remained unbroken; the diameter of the vaginal orifice not exceeding that of the little finger; and he knew of three other cases in which the male organ was not suffered to enter the vagina at all; yet impregnation took place from the mere deposition of semen on the vulva."(*u*)

Scanzoni relates a case(*u*[1]) of a single woman aged twenty-nine, who was four months gone in pregnancy when she consulted him, in whom the hymen was placed four inches from the os uteri with an aperture in it only large enough to admit a probe, and was of so dense and unyielding a nature as to eventually require a crucial incision before delivery could be accomplished.

Mattei(*u*[2]) has also placed on record the case of a woman who had been married eleven years, in whom attempts at copulation had formed a *cul de sac* which admitted the finger to the extent of one and a half centimetres, and yet, though no aperture for the passage of semen was discoverable, pregnancy was far advanced. Labor came on at the regular time, and the dense soft structures yielded after three days.(*u*[3])

§ 252. (*b*) *It may be lost from other causes than coition.*—Without insisting upon the fact of its occasional congenital absence, which, although mentioned by Capuron, is probably, as a solitary defect, extremely rare, the hymen may be destroyed by accident or disease. Siebold(*v*) mentions a case in which this membrane was destroyed by an ignorant midwife, in examining a young lady for a supposed prolapsus of the womb. He also refers to a case related by Steinberger, where a young girl, who had climbed a tree to gather fruit, fell down in such a manner that a stake, planted underneath, penetrated the vagina an inch and a half deep, producing serious injury, and of course destroying the hymen. A case, in which the hymen was lost in a somewhat similar manner, is related by Jörg. It

(*u*) Op. cit., p. 366. (*u*[1]) Allgm: Wien Med. Zeit., 1864, No. 4.

(*u*[2]) L'Union Méd., No. 36.

(*u*[3]) *Vide* also case in which the hymen was removed at labor by Greuse, Mon. f. Geburtsk. 1865.

(*v*) Handbuch, p. 102.

is sometimes destroyed by riding on horseback, by ulceration, by the first eruption of the menses, and by self-abuse. From a consideration of these circumstances it follows, that, while the hymen is far from being good proof of chastity, it may be lost and the female still be pure. Perhaps the only exception to this remark will be found in cases where the traces of its destruction are recent. Here, of course, the presumption will be, that its laceration is due to sexual connection, unless other means are apparent. Where the female supposed to be violated does not deny having previously had carnal intercourse, the signs from the presence or absence of the hymen do not come under consideration.

The other traces of sexual intercourse, such as turgescence and bruising of the parts, with heat and moisture, may, where opportunity for an early examination is given, be of some weight when taken in connection with other evidence. An interesting case of *post-mortem examination*, in which these signs were of value, may be found in *Henke's Zeitschrift*, vol. xlvi. p. 41. The external genitals were found swollen and red, the clitoris in a state of partial erection, and the vagina turgescent and very moist. The mucous membrane of the uterus was highly injected, and the mouth of the womb open. In its cavity there was found a yellowish-white liquid of gelatinous consistence, and which, from its smell and other peculiarities by chemical reagents, was evidently semen. The dead body of the woman had been found lying near a public road, with the clothes thrown up over the face, exposing the lower parts of the body, and the thighs stretched widely apart. Other marks of violence were found upon the body, but the cause of death was forcible suffocation. This opinion, given by the official surgeon, was confirmed by the subsequent confession of the criminal, that, while violating the person of the deceased, he had endeavored to stifle her cries by forcing the clothes over her face.

§ 253. (2) *Seminal stains* upon the clothing of the female form, however, the most reliable medical evidence in rape either upon children or adults. It is of course evident that they will not always be present, since none of the semen may have been shed outwardly. On the other hand, the mere pre-

presence of seminal stains upon the female's clothing is, of itself, no proof at all that violence was attempted, and still less that penetration was effected. Moreover, all that constitutes the crime of rape, including penetration, may have been completed without the occurrence of seminal emission. The detection of semen upon the female's clothing must, therefore, be regarded only as corroborative of the signs derived from the condition of the genital organs and other parts of the complainant's body, as well as from other circumstantial evidence. Practically there is considerable difficulty in ascertaining the presence of seminal spots; in illustration of this remark, we cannot do better than quote the words of the acute Dr. Casper, than whom there is, perhaps, no better authority.(*w*) He says: "In all the numerous cases which have come under my observation, I have never omitted, even when several months have elapsed since the alleged rape, to direct my attention to the *chemise*. But this is not the white, fine, and frequently changed garment of the upper classes of society, but almost without exception of coarse material, ragged, and not washed for weeks or months; the lower half presenting two large, disgusting stains, made up of a compound of menstrual blood, dirt, excrement, urine, gonorrhœal matter, etc. etc. Nothing is said of this 'in the books;' and hence the possibility of recognizing traces of semen in such a mixture is out of the question. But we have in the microscope, which, as well as I am aware, Rudolph Wagner first used for this purpose, an excellent means of diagnosis."

§ 254. (*a*) The *microscopical* characters of semen can be recognized equally in the dried spot and in the recent secretion. In the former, however, the spermatic animalcules will most probably be dead, and in a fragmentary condition. M. Bayard(*x*) has been able to recognize them in spots as much as six years old. The following directions for preparing the spots for microscopical examinations are given by M. Bayard: "The tissues covered by the stain should be allowed to macerate in lukewarm water for several hours. The liquid should then

(*w*) Vierteljahrschrift für ger. ũ öff. Medecin., Bd. 1, H. 1.
(*x*) Ann. d'Hyg., t. xxii.

be filtered, and if the spots have not entirely disappeared, the tissue should be placed in a porcelain cup with a little distilled water, and heated over an alcoholic lamp to 176° F. If any glutinous matter still remain upon the filter, it should be again macerated in water, to which a sixth part of ether or ammonia has been added. All the resulting liquids should then be poured upon the same filter. The point of this, being carefully cut and reversed upon a glass slide, should be moistened with ammonia to dissolve the fatty matters, and the paper then removed, leaving the matter to be examined upon the glass." This method is objectionable because the degree of heat and the various successive manipulations must tend to disintegrate the animalcules. Schmidt, in his valuable paper,(*y*) recommends the following simple plan, which has, moreover, the advantage that the spot need not be cut out. The inner surface of the spot, which is known by a slight shining prominence in the centre, and easy to find by the light of a candle, should be turned outward, and the tissue so folded that the middle of the spot shall form the apex of a funnel-shaped bag, which should dip in a watch-glass half filled with water. After three or four hours, warm the water in the watch-glass over an alcohol lamp, after the addition of a drop of ammonia. A drop of the water may then be examined for *spermatozoa*, and, being dried upon a glass plate, kept for future reference. Koblanck recommends the still simpler method of cutting out the suspected portion of linen, macerating it for five or ten minutes in a few drops of distilled water, and pressing it with a glass rod.(*y*[1]) Dr. J. G. Richardson(*y*[2]) says that the use of high powers of the microscope (1200–2800 diameters) enables us to detect spermatozoa with increased certainty, and that their appearance under a high objective is so characteristic, that we can easily pronounce the stain to be seminal, even if we find only imperfect specimens of spermatozoa in which the greater part of the tail has been lost.

§ 255. Spermatic animalcules exist in all animals capable of

(*y*) Die Diagnostik verdächtiger Flecke in Criminalfällen.

(*y*[1]) Canstatt's Jahresbericht, 1853, vii. 15.

(*y*[2]) Handbook of Medical Microscopy, Phila. 1871, pp. 299 and 302.

procreation, and are found in the semen of man from the age of puberty to quite an advanced period of life. "They are extremely small, scarcely surpassing the one-fiftieth, and at the very most the one-fortieth, of a line in length. The little, oval, somewhat flattened, almond-shaped, and perfectly transparent body seldom exceeds from the one six-hundredth to the one eight-hundredth of a line in length; the filiform tail at the top is thickish, and so strong, that the double contours are plainly visible, but towards the end it becomes so fine, that it cannot be followed even with the highest powers to the point; so that it is possible the delicate extremity proceeds further than it can be traced, and that the animalcule is actually longer than it can be determined to be by micrometric admeasurement."(z) It is hardly possible for one accustomed to microscopic examinations to confound spermatozoa with other objects, unless they should be *all* in a fragmentary condition. In such case, an opinion should be given and received cautiously. When *any* are found entire, we do not think that there is any other microscopic animalcule which a practised observer can mistake for them. It is important to bear in mind that the absence of spermatozoa from the suspected stains is not conclusive of their not being seminal. For it is certain that, after debilitating sickness or excessive venery, and also in old men, the seminal liquor often contains but few if any animalcules. In a case reported by Dr. Beale(z^1) fibrillæ were found in the urine bearing a certain resemblance to spermatozoa, but which were concluded to be forms of fungi.

§ 256. Casper says, that, "though stains are proved to be of seminal origin when these specific zoosperms are found in them, yet the absence of spermatozoa does not prove that these stains have not been caused by human semen," and gives the result of numerous observations in support of his statement.(z^2)

§ 257. It was formerly supposed that spermatozoa were the only bodies ever found in this connection that had motion and

(z) Wagner's Physiology, translated by Dr. Willis. London, 1841, p. 9.
(z^1) Archives of Medicine, No. iii. p. 251.
(z^2) For. Med., vol. iii. 296.

consisted of a head and tail, but M. Donné has of late described an animalcule, sometimes found in the vaginal mucus of females careless of cleanliness, which he has termed trichomonas vaginæ. It is found mixed with granular bodies larger than those often found with spermatozoa. The head of a trichomonas is three times the size of that of a spermatozoa, and has upon its circumference a row of from four to six short cilia.(z³)

§ 258. (*b*) With respect to the *chemical* relations of semen, we think little need be said. The spots are usually of a slightly yellow color, somewhat stiff, as if the tissue were starched, and give out the peculiar odor of semen when moistened. They become of a deeper color by being held near the fire, and small whitish specks become visible in them—an effect which is said not to occur with stains from other discharges. Devergie first showed that spermatic stains on linen, when held near the fire, assume a deep nankin-yellow tint, while albuminous spots remain unaltered. This method has proved successful even when the matter of a suspected stain upon some dark-colored stuff has been soaked out of it and transferred to white linen. M. Lassaigne informs us that a similar color is developed in *albuminous* stains when they are heated after having been moistened with a solution of plumbate of potassa, but this effect is not produced in spermatic stains, nor in those produced by gelatin, starch, gum, or dextrine.(*a*) Semen is alkaline, glutinous, and but slowly soluble in water. When seminal stains are not mixed with any other matter, they may be recognized by the following properties, in addition to those just mentioned. The solution obtained by macerating the stain in distilled water is not limpid, is not coagulable by heat, gives a characteristic odor on evaporation, and, when the latter is complete, there is left a shining transparent substance, sparingly soluble in water, but yielding a glutinous solution with potash. Pure nitric acid causes no precipitate.(*a*¹)

§ 259. 5th. *Feigned rape.*—The following singular case oc-

(*z*³) Guy's Forensic Medicine. London, 1868, p. 46.

(*a*) Annals d'Hygiène, 2ème sér., x. 405.

(*a*¹) For evidences derivable from traces of *blood*, *vide* BLOOD-STAINS.

curred in France. Marie V——, aged twenty-eight years, was seen to fall down, apparently in a faint, near the house of her uncle, the district schoolmaster, at the entrance of a field adjoining the public road. Her hands were found fastened by a cord, her handkerchief was tied over her mouth, her hood (capote) was drawn over the upper part of her face and fastened by pins in front of the eyes, leaving, however, a sufficient interval for the use of sight; her clothes were soiled with mud at the lower part only, and her camisole was laced. She did not apparently regain consciousness for several hours; she then related, with circumstantial detail, that she had been assaulted by four young men who had endeavored, though unsuccessfully, to violate her person. A medical examination being ordered, a vast number of superficial linear incisions were found, made apparently with the point of a knife or scissors; there were no contusions or marks of recent violence on the genital organs or their vicinity. Her clothes were not torn or crushed, and in her pockets a penknife and scissors were found, on the points of which there were slight traces of blood. The girl at last, after much hesitation, confessed that she had not been the victim of any assault, but that in a paroxysm of hysteria, without any reason to account for the strange idea which took possession of her mind, she had herself inflicted these wounds with scissors on the parts of her body which she had been able to reach. The legal proceedings were consequently stopped.(*b*)

§ 260. 6th. *Rape by females.*—An instance of this kind is related by Casper, in which a child only six years of age received a gonorrhœa from his governess, with whom he slept. In another and far more horrible case, a mother satiated her unnatural lust with her own son nine years of age, upon whose body, however, no traces of the crime were perceptible.(*b*[1]) Two cases have occurred in France, in one of which a female of eighteen years obliged a boy under fifteen years to comply with her wishes; and in another a girl of eighteen was

(*b*) Lond. and Ed. Monthly Journ., Dec. 1858, p. 550; from Gaz. des Hôp., Oct. 30.

(*b*[1]) Gericht. Med., ii. 139.

charged with rape on two children, the one of thirteen, and the other only eleven years of age. She was affected with syphilis, which she communicated to the children. It is stated also, that, from a narrowness of the vagina, she was unable to gratify her propensities with adults. The only means by which the rape can be established through medical evidence is where gonorrhœa or syphilis has been thus communicated.

§ 261. 7th. *Pœderasty.*—This unnatural crime demands but little notice from us. It has been customary for authors, in describing the physical results of this vice, to enumerate various local injuries, such as laceration and a patulous condition of the sphincter ani, prolapsus of the rectum, and ulcerations, together with constitutional effects, as consumption, dropsy, etc., as the inevitable results by which the commission of it could be ascertained. Tardieu,(*c*) speaking of the recent signs of unnatural violence, says that they are found to differ with the amount of force employed, the size of the organs, the youth of the victim, and his freedom from previous pollution of the same kind. In different cases they vary from redness, excoriation, and painful heat in the anus, and difficulty in walking, to fissures, lacerations, extravasation of blood, and inflammation of the mucous membrane and its subjacent cellular tissue. The observations of Parent-Duchatelet,(*c'*) and of Casper,(*d*) show, however, that such consequences are far from being even the common effect of this disgusting vice. The former of these authors speaks from a long experience; he says that he has *never* observed the results above enumerated. Dr. Casper, in a valuable monograph on this subject, in which he communicates a number of cases which fell under his notice, says, that none of the signs enumerated by authors are to be depended upon. In one case, however, mentioned by him,

(*c*) Attentats aux mœurs, p. 123.

(*c'*) De la prostitution dans la ville de Paris, vol. i. p. 225.

(*d*) Vierteljahrschrift für ger. u. öff., Med., Bd. i. H. 1. Also Ibid. Bd. vii. H 2. For an historical account of the vice, see "Geschichte der Lustseuche im Alterthume nebst ausführlichen Untersuchungen über den Venus und Phalluscultus, Bordelle, Νουσος βήλεια der Skythen, Pöderastie und andere geschlechtlichen Ausschweifungen der Alten, etc." By Dr. Julius Rosenbaum. Halle, 1845. 8vo.

in which a medical examination was obtained *immediately* after the commission of the crime, the sphincter ani was lacerated to the depth of two lines, and the parts irritated and painful. The most frequent result which he witnessed may be described in the words of Zacchias, strangely heretofore overlooked: "Multo magis frequentem tam nefandi coitus usum significare poterit ipsius podicis constitutio, qui cum ex natura rugosus existat, ex hujusmodi congressu lævis ac planus efficitur, obliterantur enim rugæ illæ in ani curriculo existentes ob assiduam membri attritionem." He also describes a funnel-shaped depression of the nates, as a frequent result. It should be remembered, however, that these observations were made upon persons whose lives had been spent in the practice of this degrading vice, or who had been for a considerable time in the practice of it. Syphilitic ulcerations or growths, in these parts, although of suspicious origin, may be really due to other causes than a direct transmission by unnatural connection. Marks of violence may be naturally expected in young persons.

§ 262. The frequency of this crime is probably much greater than the statements above quoted from Parent-Duchatelet and Casper would seem to indicate. Tardieu states that on two occasions the sudden descent of the Parisian police upon certain dens of vice resulted in the capture of eighty-seven in the one, and of fifty-two in the other, persons found *flagrante delicto*. From these in part he obtained the perfect confirmation of the description of Zacchias in regard to the signs of this vice when habitually indulged in. In two hundred and five cases of avowed criminality, these indications were wanting only fourteen times. In addition to the details already given, he describes relaxation of the sphincter ani, dilatation of the anus, incontinence of feces, ulcers, piles, fissures, fistulæ, etc., as consequences of this detestable crime.

It is unfortunate that there is no medical evidence by which the crime can be be brought home to the *active* transgressor; Tardieu, however, describes as effects of habitual indulgence in it, a tapering form of the whole penis, when this organ is slender, and when it is of large dimensions, a similar shape of the glans alone.

LEGAL RELATIONS OF RAPE.

§ 263. 8th. The points to which medical testimony is most likely to be invited, in prosecutions for rape, are the following:—

1st. Submission of prosecutrix, § 264.
- (*a*) From artificial stupefaction, § 264.
- (*b*) From ignorance of the nature of the act, § 269.
- (*c*) From mistake of person, § 275.
- (*d*) From fear, § 276.

2d. Prior want of character of prosecutrix, § 277.
3d. Subsequent suppression of the fact by prosecutrix, § 279.
4th. Extent to which coition was carried, § 280.
5th. Want of age of defendant, § 285.
6th. Want of sexual capacity of defendant, § 286.

The law on each of these points will be now briefly considered.

1st. *Submission of prosecutrix.*—This may happen from either of the following causes:—

§ 264. (*a*) *From artificial stupefaction.*(*a*)—It makes no matter whether the drug was given for the purpose of producing stupefaction, in order that the rape might be effected on the female thus made unconscious, or whether it was administered for the purpose of causing sexual excitement, and thereby leading to a voluntary submission. It is rape in either case; the law being, that the overcoming of chastity, and the destroying of resistance by artificial means, is rape, when the offence is consummated. If the result of the dose be stupefaction, and if, on the woman thus become insensible, carnal intercourse be effected, it is rape, though the intention was merely to excite. Thus, where the prosecutrix was made drunk by the prisoner, who then violated her person, it was held in England, where, from the offence being capital, it is

(*a*) See the medical relations of this point, *ante*, § 242.

kept within its strict common law limits, that the crime was rape, though the jury expressly found that the liquor was given with the intent of *exciting*, not *stupefying*.(b) And in this case it was held, that where the insensibility is the defendant's act, and where the defendant knows that "the act was against the prosecutrix's consent at the last moment she was capable of exercising her will," it is rape. On this point agreed all the ten judges of England, constituting the final Court of Revision in criminal causes; and it was not required by the exigencies of the case that they should go further. Several, however, thought—and this view is in accordance with the analogous cases to be hereafter noticed—that the crime was consummated by the mere act of knowingly violating an insensible woman, whether the insensibility was produced by the defendant himself or not.

§ 265. In a case of subsequent date in New York, the indictment charged that the defendants committed a rape upon one Mary A. Williams, also counts for assault with intent to commit a rape, and for simple assault and battery. The evidence showed that the defendants got the girl intoxicated, and then, it seems, two of them raped her, the others being present at the time. The girl was proved to be a common prostitute. The defendants were found guilty on the second count. The case came before the Supreme Court on exceptions to the judge's charge. In delivering the opinion of the court, Judge Johnson said, "The judge, among other things, charged the jury, that, if they should find, from the evidence, that the girl and the defendants were drinking together voluntarily, and afterwards went out together, without any assignation having been made, or any consent on her part to have sexual intercourse with them, and she became insensible from the liquor thus drank, and while in such condition the defendants violated her person, they would be guilty of rape." "It has, I think, never yet been held that merely having carnal knowledge of a woman while deprived, by voluntary intoxication or otherwise, of all reason and volition, without

(b) R. v. Camplin, 1 Car. & K. 746; 1 Den. C. C. 89; Wh. Cr. Law, § 1140; and see Com. v. Burke, 105 Mass. 376; State v. Stoyell, 54 Maine 24.

her consent, and by such force only as was necessary to accomplish the act under such circumstances, was a rape." The point, however, on which the court relied in granting a new trial was, that, in New York, carnal intercourse with an intoxicated woman is by statute an independent offence, and not rape.(*c*)

§ 266. In the prosecution of Dr. Beale, in Philadelphia, in 1854, which has been noticed above,(*d*) the point was not made, and it was assumed by both sides, that carnal intercourse with a woman who was stupefied by chloroform was rape, though the chloroform was administered, at her request, for the purpose of facilitating the extracting a tooth. And if this be the law —and the cases to be subsequently noticed unite with the reason of the case in indicating that it is—it goes to establish the broad position, that rape is sexual intercourse with a woman, not *against*—as has been formerly said—her will, but *without* it.

§ 267. In January term, 1860, Dr. Davis Green was tried before the Common Pleas of Mercer County, Ohio, for a rape on Jane Gray. According to the statement before us, which was prepared by the defendant's counsel for the *Western Law Monthly*,(*e*) the prosecutrix was a "truthful, virtuous girl, robust and healthy, of limited education and intelligence, though of good natural sense, aged seventeen years on the 21st of August, 1857." The evidence, according to the same statement, was that "on the night of the 23d of June, 1857, she lodged in bed with a daughter of defendant of about the same age, in the northeast corner room of a village hotel, in Mercer County; that in the adjoining room, south, there lodged a man and his wife, and in the adjoining room, west, with an unfastened door between them, there lodged the defendant, and other persons in other beds; that the prosecutrix and her bed companion retired about 10 P. M., and after talking a short time fell asleep; that during the night, the first thing remembered by the prosecutrix was that the defendant had her by the arms, pulling her out of bed; that he said he was Dr.

(*c*) People *v.* Quin, 50 Barbour 128; Wh. C. L., § 1128.
(*d*) See *ante*, § 245. (*e*) April, 1860, p. 183.

Green, and he had come to have sexual intercourse with her; that he placed her in a position with her feet touching the floor, and her weight partially resting on them and on the pillows; that in that position he had complete sexual intercourse with her; that she experienced the pain of rupture of the hymen, but experienced upon her clitoris a pleasurable sensation from the coition; that the act lasted but a few minutes; that upon leaving her the defendant said to her she must never tell it, that it would not hurt her; that he held his hand upon her mouth, and she felt a rag between his hand and her mouth; that she heard what was said, was conscious of all that occurred; that she tried to speak, but felt so weak and scared that she could not, or would not speak aloud, and did not say but a word or two—said, 'Go away; oh dear!' that she tried to force him away, but could not; that she experienced a ringing sensation in the head, felt weak, drowsy or sleepy, but did not sleep any more that night; that she remained in bed until morning, made no outcry, and told no one of the occurrence until about the last of December, 1857; that next morning she felt unwell, and presented a sad and gloomy countenance, and for a week or two was nervous and easily alarmed; that the ringing in the head lasted a day or two; for three or four days she could not sit up for any considerable time; the symptoms of the weakness lasted two weeks; that this time, 23d June, was the usual period for the return of the menstrual discharge, and symptoms of it were felt, but no actual discharge had yet occurred; that on the morning of the 24th she observed a spot, as of blood, on her chemise, the only night dress she wore, which she supposed was a slight menstrual discharge, but that no discharge followed at any time thereafter; that she conceived and gave birth to a child on the 26th March, 1858; that after retiring to her room on the 23d June, before going to bed, her nose bled; that she never saw chloroform before, but smelled it on trial, and believe the smell to be like that she experienced on night of 23d June; that she first thought defendant had intercourse with her twice that night, and told others so, but, on reflection, was sure it was only once; that she saw him with shirt and drawers on, but had no other clothing; that she made an

effort twice with both hands to resist him, but could do nothing; she weighed 130 pounds; was in good health, and had always enjoyed good health; did not smell medicine when first awoke, but did after defendant left her room, in about six minutes; the effect was unpleasant, cannot say painful; that her mind was clear from the time she awoke, and she knew everything; her feet were about six inches; more than half her weight on her feet, the rest thrown back on the upper part of the bed; the rail of the bed came in contact with the middle of her thighs; she made no effort to awaken the daughter of defendant, though her hand was near or touching hers; did not halloo nor call any body; her hands were not restrained at any time; defendant only touched her with one of his hands; is sure she remembers everything that occurred accurately."

The defendant was a physician. A large amount of evidence was offered to prove or disprove the offence. The defendant's daughter, a highly intelligent young lady, testified that she was not disturbed, perceived no odor of medicine in the room, and noticed nothing unusual in the appearance of prosecutrix the next morning. The defendant was just recovering from a long and severe attack of phlegmonous erysipelas. The left hand very sore; poulticed; the neck very stiff and sore, and the right hand also sore and in ulcers. No one about the house heard any noise or disturbance during the night, after parties had retired. The partitions between the rooms were of boards; had stood twenty years; had shrunk so that there were cracks between them nearly an inch in width. The boards were an inch in thickness. The bed of ordinary size.

It was also testified, as we learn from the judge's notes, that the defendant, before retiring to bed, took a vial from his pill-bags, which he said contained a weak solution of chloroform; that he bathed the court-plaster on his hand with it, saying that it relieved pain; that he took this vial up to bed with him, saying that he might need it in the night, if his hand became painful; that when he retired he asked which room the girls were in, and selected a bed near the door of their room, saying that he could be near the girls and could wake them early; that he rose before them next morning, and they were called to breakfast by other persons.

He offered no evidence as to his character. He is a married man, age over forty years.

A witness swore (without objection) that he once, under the influence of chloroform, had a tooth which the surgeon endeavored to pull, but it broke off, when an effort was made to extract the root with a screw; that he saw, heard, and knew all, but his volition was overcome—had no inclination to resist.

The court (Lawrence, J.), in charging the jury, adopted substantially the views in the text. The defendant was convicted, and a motion for a new trial refused. But to this decision the same objection applies as that heretofore urged to the conviction in Com. *v.* Beale, *i. e.*, that it is unsafe to convict when the sole proof of the *corpus delicti* rests on the evidence of a witness who, at the time of the alleged act, was under the influence of a stimulant which it is admitted is apt to work erotic imaginations. In the case immediately before us, it is true, there was subsequent pregnancy, which was not shown in Com. *v.* Beale. But in neither case was there any medical examination showing sexual intercourse to have been at the time consummated; and in the present case, there was no complaint made by the prosecutrix until months after the alleged rape, at a time when she found herself pregnant. Testimony of witnesses as to what took place when they were under the influence of chloroform, should be subjected to the same tests as those applied to insane witnesses. Such testimony cannot be safely excluded.(*f*) But there should be always in such cases proof of the *corpus delicti aliunde*.(*f*[1])

(*f*) See vol. I. § 242.

(*f*[1]) From the judge's charge we extract the following:—

"When the *will* acquiesces in *coition*, there cannot, as a general rule, be any rape. But the acquiescence which defeats a prosecution for rape is that of a will so far under the enlightened guidance and control of the other faculties, that the mind can fairly comprehend the nature, and judge of the consequences of the act, unless, as before stated, the defect of capacity is unknown to the accused. (The judge, in a previous part of the charge, had said, that, if the prosecutrix had the capacity to understand the nature and judge of the consequences of sexual intercourse, and the power to resist it by act or word, and neither such capacity nor power was overcome by force, fear, or chloroform, her acquiescence in the act would defeat a prosecution

§ 268. The subject of the criminal employment of chloroform is hereafter separately considered.(*g*)

for rape.) If the faculties have been, to some extent, suspended by chloroform, but enough remain to reasonably comprehend the nature, and judge of the consequences, of the act, their acquiescence in coition will defeat a prosecution for rape.

"But if, through the influence of chloroform, either directly upon the will or the *consciousness*, or other *faculties* of the mind or the *sexual feelings* and emotions, the mental capacity is so benumbed, suspended, or perverted as to be unable reasonably to comprehend the nature and judge of the consequences of coition, and by reason of such condition, known to the defendant, the act is acquiesced in or consented to, such acquiescence or consent will not alone defeat a prosecution for rape. Rape may exist with such acquiescence, thus knowingly obtained.

"It is of the utmost importance that you should ascertain whether chloroform was administered; and if so, whether it deprived the prosecutrix of mental and physical powers.

"If it be assumed (and whether it be, is for the jury to say) that there is evidence tending to show that chloroform was administered to the prosecutrix while asleep; that sexual intercourse was had with her; that she partially or wholly awoke before it commenced; that she was conscious of it, and of the movements attending it; that she could and did hear and understand words spoken in a low tone; that the intercourse produced upon her clitoris a pleasurable sensation; that this was preceded by the pain of a ruptured hymen; that she did not speak; that she felt a desire to resist physically, endeavored to do so, but could not; that the act was followed by pregnancy, and the birth of a child in 276 days; that she was a vigorous girl, in her seventeenth year, virtuous, truthful, of limited education and intelligence; that the act was at the proper time for the return of the menstrual period, but before any actual discharge; it will be important to ascertain whether there is any stage in the effect of chloroform upon the human system where these facts can exist consistently with the idea that such intercourse could be had without her consent.

"The inquiry may be assisted by ascertaining whether the various powers of the mind and body fade away under the influence of chloroform, gradually and coequally, and return in like manner, as the influence passes off; or whether some—and if so, what ones—precede others in thus fading away and being restored, and the order thereof, in all the various stages of the influence; and whether some—and if so, what—faculties are retained, and the extent and capacity of them.

"In the case which I have assumed, where the sense of hearing remained, and the sensations of pain and pleasure were felt in a greater or less degree, these facts would tend to show that the stage or condition of *anæsthesia* had either not been reached, or was past; and, if so, it might be much more pro-

(*g*) See *post*, title "Chloroform."

§ 269. (*b*) *From ignorance of the nature of the act.*—A striking instance of this is to be found in the case of the imbecile girl

bable that memory would retain its power than if the facts were otherwise. And if the capacity to remember existed, statements made by its aid might be reliable. But as failure to resist by *word* and *act*, having the capacity to do so, would be strong if not sufficient evidence of acquiescence in the *coition*, it would at once become necessary to determine if the faculties of *hearing* and *feeling* could coexist in a sound body, without either the capacity to speak or make forcible resistance. If that be not possible, then due weight should be given to such consideration, in determining whether she acquiesced in the coition. But if the capacity to hear, feel, and remember be consistent with incapacity to speak or forcibly resist, then the evidence of guilt may thereby be enhanced. What may be the truth, you will determine from the evidence in the case.

"But if the prosecutrix had the capacity to hear, feel, and remember, and a capacity to speak and forcibly resist, but the inclination to do so was lost, the will overcome by the action of chloroform, either operating upon the *will* faculty, or the *judgment* and *reflective* faculties (or sexual emotions), so that the mind was thereby incapable of fairly comprehending the nature and consequences of sexual intercourse, and the defendant, knowing these facts, had unlawful carnal knowledge of her, forcibly, that would be a rape. And it would in such case be wholly immaterial whether the entire mind was disordered and overthrown, or only such faculties thereof as are rendered incapable of having just conceptions, and drawing therefrom correct conclusions, in relation to the alleged rape.

"Whether the physical or mental capacities I have named could operate normally while other faculties of the mind—as the judgment, the understanding, the reflective and reasoning faculties—were so deranged or overthrown as to destroy the capacity to comprehend the nature and consequences of coition, is a question of fact for the jury to determine, upon all the evidence in the case.

"But if the prosecutrix had the capacity to hear, feel, remember, speak, and to resist, or in any event, it should not be presumed her will was overcome, without proof of that fact beyond a reasonable doubt.

"If chloroform may produce *delusion* in the mind of its subject in any one of its stages, you will inquire if it existed in this case; whether its existence is consistent with the other mental and physical phenomena which you may find to have existed; and you will give due effect to your conclusions on this subject.

"With these principles as to what are necessary to constitute a rape, the jury will proceed to inquire into the prominent points of controversy, and ascertain if it is proved that the defendant forcibly had unlawful knowledge of Jane Gray; and if so, was it against her will?"

(The judge then read to the jury section 212 of 3 Greenl. Ev., and section 468 of Wharton and Stillé's Med. Jur., and called the attention of the jury to the prominent points of evidence relied upon to prove and disprove the fact of sexual intercourse, and upon the subject of acquiescence.)

already mentioned, who had no notion of what the sexual act consisted, and who was totally unable to account for her pregnancy, except by the statement that her cousin had played with her on the sofa.(*h*)

§ 270. It is no defence, therefore, that the party ravished gave consent, or even aided in the commission of the offence, when from her very tender years she is to be presumed incapable of knowing the nature of the act.(*i*)

From the same reasoning it results that it is a rape to have carnal intercourse with an idiotic, imbecile, or insane woman, even though without dissent, she being incapable of intelligent submission.(*j*)

The defendant was convicted, and a motion for a new trial refused. The result has been commented on in the text. Of the fact there stated, that under certain stimulants erotic imaginations are engendered, the following illustration may be given, from the *Providence Journal*, of August 13, 1872:—

"A very singular and remarkable case of hallucination induced by the use of a cosmetic, has lately occurred in Methuen. A young woman living in that town went to Lawrence on Saturday evening last, and on her return to her home, late at night, reported that she had been cruelly assaulted by three men, about twenty rods from her father's house, and that she was left insensible and badly hurt. Physicians have examined the case, and find that several days ago this girl purchased a bottle of preparation kept at the apothecaries', known as "Soule's Infallible Moth, Tan, and Freckle Eradicator." This preparation she used for four days, applying it externally upon her face and profusely upon her forehead. On Thursday, the fifth day after commencing its use, she was taken with sickness at the stomach and a feeling of general debility of the entire system. She was obliged to leave her work at the mill and go home, and remained quite ill from this time till Saturday evening, at the time of this occurrence. The physicians say no such assault has been made as she alleges, and they are of the opinion that the girl was laboring under an hallucination, which might have been caused from the use of this preparation, as one prominent ingredient of it is corrosive sublimate, which is a poison, and its application upon the brain externally would have a tendency to produce a sort of insanity."

(*h*) *Ante*, § 248.

(*i*) Hays *v.* People, 1 Hill, N. Y. R. 351.

(*j*) State *v.* Farr, 28 Iowa 397. See Com. *v.* Burke, 105 Mass. 376. In an Ohio case the defendant was indicted—1. For having committed a rape on the person of Louisa Dowler; 2. For an assault with the intent to commit a rape on said Louisa; and, 3. For having carnal knowledge, she, the said Louisa, being an insane woman, and he, said defendant, knowing her to be such. The defendant pleaded not guilty, and the cause was tried by a jury at the March Term of the Court of Common Pleas. The evidence on the

271. In England the rule is, there must be some evidence that act was without the consent of the woman, even where

proved that the said Louisa Dowler was of unsound mind, and had been om her nativity: though she was not so absolutely destitute of mind that did not perform the necessary functions and calls of humanity; but that had not mind enough to testify as a witness or to be held legally responsi- or her acts, whether civil or criminal. The words of the statute are: t if any male person, 17 years old and upwards, shall have carnal knowl- of any other woman than his wife, such woman being insane, he know- her to be such, every person so offending shall be deemed guilty of a emeanor, and upon conviction thereof, shall be imprisoned in the peni- ary and kept at hard labor not more than ten nor less than three years. Knowles for the State, Messrs. Nye and Jewett for defendant, claimed the said Louisa, being an idiot, had no will, and therefore that a rape i not be committed on her person against her will: it was further claimed the word insane, in the 6th section of the act, did not embrace an idiot, hence the defendant could not be convicted of either of the charges em- ed in the indictment. Mr. Justice Nash.—It is claimed, *first*, that a fe- idiot is not the subject of a rape; that she has no will, and hence an act ot be done to her person against her will. No authorities are cited for startling position. On looking into the books I can find no such distinc- intimated; and if such was the law, it is singular that so important a lification of the crime of rape should not have been noticed hitherto in any atise on this subject. Rape is defined to be, the having carnal knowledge a female *forcibly and against her will*. There is here no limit to the use the word female; nothing said as to the soundness or unsoundness of her ind as to idiocy or insanity. In this respect our statute follows the common w, and must therefore be construed as the same words were construed in he definition of the crime at common law. There is another consideration ot to be overlooked. The section providing for punishing assaults with a riminal intent, declares that an assault committed on another with the intent o commit a rape, shall be criminal. Now, if a rape cannot be committed on he person of an idiot, then it is no crime to assault her person with such an ntent. The same question applies also to assaults committed on an insane erson; since this argument places them without the protection of the law unishing the crime of rape. Nor are insane persons protected under the th section, since the crime there described is committed only when the per- etrator knows the woman to be insane. Indeed, that section is clearly limited o the case of a male person's knowingly having sexual knowledge of an in- ane female without resistance on her part, and with her acquiescence. Hence his section cannot be made to embrace the case of one having such sexual ntercourse forcibly and against the will or resistance of such insane female. t is further claimed that an idiot is not an insane person under the meaning f that term in the 6th section. The result, then, follows, that a female idiot left wholly unprotected against this class of crimes. A person cannot be unished for having carnal knowledge of her person forcibly and against her

she is an idiot. In such a case, where there were no appearances of force having been used to the woman, and the only

will, as she has no will to overcome; she is not an insane person, and is not under the protection of the 6th section, and neither an idiot nor an insane female is protected against assaults with intent to commit a rape, since a rape cannot be committed on the person of either. It must require some very intelligent reasoning, or some very convincing authorities, before the court could be induced to give a construction to a statute which must lead to such results. But here is no such authority; no such decision has been found. Is there any more force in this reasoning? Let us examine it for a moment. In the first place, where the carnal knowledge is had by *force*, it must be against the will of the female. Nor need there be any direct evidence of this action of the will; the law implies the want of consent from the force itself. It is the *consent* of the female which takes away all criminality from this connection; it is this want of consent which renders this connection, obtained by force, criminal. Hence if an idiot has no will to be overcome, she has none to consent, and then the law implies that the act being accomplished by force is done against her will. But is it true that an idiot or insane person has no will? What is the definition of these two words? Do they imply a loss of *will* or a mere unsoundness of mind? These words are thus defined by Webster: "Idiot—a natural fool, a fool from birth; a human being in form, but destitute of reason or the ordinary intellectual powers of man. Insane—unsound in mind or intellect; mad; deranged in mind;" and one of the words used to define *insanely*, is *foolishly*. Fool is defined to be one who is destitute of reason or the common powers of understanding; an idiot. Some persons are born *fools*, and are called *natural fools;* others may become *fools* by some injury done to the brain. In Chitty's Medical Jurisprudence, p. 348, an idiot is defined to be "a person who has been *defective* in intellectual power from the instant of his birth, or at least before his mind had received the impression of any idea." Again, Chitty says "that idiocy consists in a defect or sterility of the intellectual powers; but it may be induced in after life, while lunacy or madness consists in a perversion of intellect." All these definitions imply either a *weakness* or *perversion* of the mind or its powers, not their *destruction*. The powers are still all present but in an impaired and weakened state. Hence an idiot cannot be said to have no *will*, but a will *weakened and impaired*—a will acting, but not acting in conformity to those rules, and motives, and views which control the action of the will in persons of sound mind. Indeed, in an insane person the will is too often fearfully active, and wholly uncontrollable by reason or persuasion. There is here no lack of will, but simply a *perversion* of it. Nor is this the most conclusive answer to this argument. If there is no will, how are voluntary actions continued? Not only actions which, like respiration, are instinctive, and independent of the will; but eating and numerous other acts which necessarily imply the exercise of the will are performed by idiots and insane persons; and their exercise demonstrates the existence of a will—of a will which can assent to, or dissent from, what are clearly voluntary acts. I have therefore

ence of the connection was the prisoner's own admission, led with the statement that it was done with her consent, as held, that there was no evidence for the jury.(*k*)

sitation in holding, that both idiots and insane persons are possessed of , so that it may be legally and metaphysically said, that a carnal knowl- may be had of their persons *forcibly* and against their will. The next y is, what is the proper construction to be given to the word *insane?* e 6th section of the act for the punishment of crimes, Curren's Re- Statutes, p. 184, that section provides: "That, if any male person teen years old and upward shall have carnal knowledge of any woman than his wife, such woman being *insane*, he, knowing her to be such, be deemed guilty," etc. It is claimed that this word *insane* does not ce a female who is an idiot. We have already seen that idiocy may be ed after infancy, as well as be congenital, Chitty's Med. Jurisp. p. 347, hat both terms are defined by the same words, *unsoundness of mind.* e one case this unsoundness of mind develops its existence in want of ty to reason at all; or, at least, in a much less degree than the gene- of mankind; while in the other there is, perhaps, greater acuteness, upon false and fancied hypotheses. (Chitty's Med. Jurisprudence, p. Still, in both cases, unsoundness of mind is the cause. The very ori- the word *insane* demonstrates this; in its Latin origin, it is a word meaning *unsoundness* and nothing more; and in the popular language ed in this sense to this day, whatever may be the specific meaning at- to it by writers on mental diseases. If, then, the object and policy of atute embraces idiots as well as lunatics, there is nothing in the use of rd *insane* which absolutely precludes us from giving that elementary ng to the word in this statute. The reason of this provision clearly to idiots as well as to lunatics; if there is any reason in the case ale lunatics, why sexual intercourse with them should be prohibited, y strong is the reason why it should not be permitted with female idiots. offspring in one case might be affected with insanity, so in the other it with idiocy. Whatever reason, therefore, can be found to so declare w in relation to female lunatics will apply equally forcibly to idiots. If e class ought to be protected, equally so ought the other. Such, then, the manifest scope of the law, I can have no hesitation in concluding such was the intention of the legislature; that this word *insane* was in its elementary and popular meaning, as descriptive of that unsound- of mind, which renders individuals civilly and criminally irresponsible eir acts, whether the unsoundness uncloses itself in idiocy or lunacy. cordance with these views I hold that a female idiot, or an insane female, e subject of rape, and hence of an assault with the intent to commit crime; and that a male person, of proper age, who shall have carnal ledge of a female idiot, knowing her to be such, is guilty, under the

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R. *v.* Fletcher, 1 L. R., C. C. 39; 12 Jur., N. S. 535; 35 L. J., M. 2; 14 L. T., N. S. 573.

In a prior case the prisoner was convicted of a rape upon the prosecutrix, who was an apparent idiot. She proved the act done, and said that it was wrong, but that she said nothing to the prisoner, and that she did not do anything to him, and that she did not like to hurt nobody. The constable told the prisoner that he was charged with committing a rape upon the prosecutrix, and against her will. The prisoner, in answer to that, said, "Yes, I did; and I'm very sorry for it." It was held, that there was evidence to sustain the conviction.(*l*)

But the present (1872) English rule undoubtedly is, that, while, if there is actual incapacity to assent, and force is used, the offence is rape,(*m*) yet there must be some evidence, in all cases, to disprove assent, and, if there be not, a conviction should not be sustained.(*m*[1])

§ 272. Somewhat in the same sense the law is expressed in a late (1865) able opinion of the Supreme Court of Michigan. Rape at the common law or under the statute of Michigan, it was held, is not committed upon the person of a woman over ten years of age, where no circumstance of either force or fraud accompanies the carnal knowledge. Where, therefore, a man had criminal connection with a woman of mature age, of good size and strength, but who was shown by the testimony to be in a state of *dementia*—not idiotic, but approaching towards it; and it appeared that no fraud or force was used by him, it was held as not constituting a rape.(*n*)

§ 273. But suppose the woman was mentally sound, and an adult, but submitted from ignorance as to the sexual character of the act?

In England this point received a judicial decision on the trial of a physician, who had sexual connection with a young

6th section, of having carnal knowledge of an insane woman, knowing her to be such. The jury were so charged, and they returned a verdict of guilty of an assault with an intent to commit a rape, and not guilty on the other two counts. And sentence was passed on the prisoner.—State *v.* Crow, Common Pleas of Athens County, Ohio.—*Western Law Journal*, vol. x. pp. 501–5.

(*l*) R. *v.* Pressy, 17 L. T., N. S. 295; 16 W. R. 143; 10 Cox., C. C. 635.

(*m*) R. *v.* Fletcher, Bell C. C. 63; 8 Cox C. C.

(*m*[1]) R. *v.* Fletcher, 1 L. R. C. C. 39 *ut supra*.

(*n*) Crosswell *v.* People, 13 Mich. 427.

girl, who made no resistance, solely from a belief that the defendant was, as he represented, treating her medically. All the judges held the case was rape.(*o*) And it was said in another case, where the patient was directed to lean forward, for the purpose of receiving an injection, and where sexual intercourse was then attempted, that the defendent was guilty of an assault.(*p*)

§ 274. In a more recent case in New York, the prisoner was indicted for a rape upon Lucy S. Jones, and was convicted in the court below. The facts of the case are sufficiently stated in the opinion of the court, which was given by Gilbert, J. "The plaintiff in error is a physician. The prosecutrix is a single woman, thirty years of age. The commission of the offence rests upon her testimony alone. Her evidence, briefly stated, is, that the plaintiff in error, while attending her in a professional capacity, told her that she had a disease of the womb, and that a physical examination was necessary; that she submitted with much reluctance; that he had carnal connection with her on two occasions, while professing to be making such examination; that this occurred in the parlor of her brother's house, while the wife of her brother was in an adjoining room; that she made no outcry." "No one, we think, would seriously contend that such a statement, made by a female of mature age, and possessing any intellectual capacity, ought to be allowed to become the basis of judicial action." The court below charged the jury that, in a case like this, "the force used in ordinary sexual intercourse is sufficient to constitute a rape." In the Supreme Court this was held to be error.(*q*)

§ 275. (*c*) *From mistake of person.*—Very early in the judicial history of this country, a conviction of rape was sustained in New York by a very eminent judge—Thompson, C. J.—upon evidence showing that the prosecutrix mistook the defendant for her husband, and permitted his embraces,

(*o*) R. *v.* Case, 19 L. J., M. C. 174, 1 Den., C. C. 580; 4 Cox, C. C. 220; Wh. Cr. Law, § 1143.

(*p*) R. *v.* Stanton, 1 Car. & Kir. 415.

(*q*) Walter *v.* People, 50 Barbour 145. This decision is severely criticized by Dr. Storer, in Journal of Psych. Med., ii. pp. 49–506.

under that impression.(r) The same point was again ruled in subsequent cases: one in New York,(s) and another in Connecticut.(t) In England it was at first thought that such evidence would not sustain a conviction;(u) though afterwards convictions of the assault with intent, were ordered.(v) But more recently it has been ruled that non-resistance to connection, permitted under a misapprehension induced by the conduct of the man, by a woman conscious and capable of consenting, amounts to consent, though unintentional, and prevents the offence amounting to a rape.(w)

In conformity with this principle, where the evidence was that a woman, with her baby in her arms, was lying in bed between sleeping and waking, and her husband was asleep beside her, and she was completely awakened by a man having connection with her, and pushing the baby aside, and almost directly as she was completely awakened she found that the man was not her husband, and awoke her husband; it was held, that a conviction for a rape upon these facts could not be sustained.(x) The same view has been taken in Virginia, Tennessee, and Alabama.(y)

§ 276. (d) *From fear.*—The crime (except in the cases just noticed) cannot be considered as consummated, unless the prosecutrix resisted as much as she could. Submission, however, caused by terror, the prisoner knowing it to be such, is no defence.(z) And where a father has established a kind of reign of terror in his family, and his daughter, under the influence of dread and terror, remains passive while he has connection with her, he may be found guilty of rape.(a)

§ 277. 2d. *Prior want of character of prosecutrix.*—While it is no defence that the woman was a common strumpet, or even

(r) 1 Wheel. C. C. 381. (s) People v. Metcalf, 1 Wheel. C. C. 378.
(t) State v. Shepard, 7 Conn. 54. (u) R. v. Jackson, R. & R. 487.
(v) R. v. Saunders, 3 C. & P. 265; R. v. Williams, id. 286.
(w) R. v. Barrow, 38 L. J., M. C. 20; 1 L. R., C. C. 156; 19 L. T., N. S. 293; 11 Cox, C. C. 191.
(x) Ibid.
(y) Wharton's C. L. § 1142. See also Lewis v. State, 30 Ala. 54.
(z) Wh. C. L. § 1142; R. v. Rudland 4 F. & F. 495; R. v. Jones, 4 L. T., N. S. 154; R. v. Wright, 4 F. & F. 967.
(a) R. v. Jones, 4 L. T., N. S. 154.

that she was the defendant's mistress, the question of prior chastity is always a material one to be considered by the medical examiner, since unchastity can be shown by the defendant, not as an excuse or justification, but as a fact throwing much light on the value of her testimony. Thus it has been expressly decided, that it is competent for the defendant to show that the prosecutrix's previous character for chastity was bad,(*b*) and that she had before been connected with himself; though the general opinion in England has been, that he cannot show particular acts of unchastity except those committed with himself.(*c*) But, even in England, a wider range seems now to be encouraged, it having been held admissible to ask the prosecutrix "whether she was not, on the Friday last, walking on the high-street to look out for men," and, upon her denying this, to call witnesses to contradict her.(*d*) And it has been in some States ruled that the prosecutrix may be asked whether she had not had previous connection with other men; and that, in such case, she is not privileged from answering.(*e*)

§ 278. The *object* of such testimony is twofold: 1st, in making the fact of *coercion* less likely, and, 2d, in diminishing the witness's weight as respects credibility generally. It is less likely that a strumpet, or one holding herself out as submitting to illicit intercourse, though on special inducements or occasions alone, would resist to the extremity which a prosecution for rape requires, than would a chaste woman. And although, under ordinary circumstances, it is inadmissible to impeach *veracity* by attacking *chastity*, yet, in such an issue as the present, this seems but proper. Such being the case, it will be seen that medical testimony as to the prosecutrix's prior condition is of peculiar value. Evidence of any prior venereal complaints, or of any other facts tending to prove

(*b*) See Pratt *v.* State, 19 Ohio St. 277.

(*c*) R. *v.* Hodgson, R. & R. 2; R. *v.* Clarke, 211 Stark. 243; R. *v.* Barker, C. & P. 589; R. *v.* Martin, 6 C. & P. 562. See People *v.* Abbott, 19 Wend. 192; Campo *v.* State, 3 Kelley, 417. Whar. C. L. §§ 1149–51.

(*d*) R. *v.* Barker, 3 C. & P. 589; R. *v.* Robins, 2 M. & R. 512.

(*e*) People *v.* Abbott, 19 Wend. 192; State *v.* Reed, 39 Vt. 417; State *v.* Murray, 63 N. C. 31; State *v.* Forshner, 43 N. H. 89. *Contra*, McCombe *v.* State, 8 Ohio St. 643; Com. *v.* Regan, 105 Mass. 593. See Pratt *v.* State, 19 Ohio St. 277; Wh. C. L. § 1151.

previous illicit intercourse, it is always proper, under such circumstances, to receive.

§ 279. 3d. *Subsequent suppression of the fact by prosecutrix.*—It is here that the presence or absence of a medical examination tells most forcibly. The omission of the friends of the injured party to obtain an instantaneous medical inspection may be their misfortune, arising from ignorance or false shame; but it is better that they should suffer from it, in the acquittal of the offender, than that the stimulus to supposititious prosecutions be given, which will always result from dispensing with this most salutary check. It is not, of course, pretended that the *want* of immediate medical inspection is a legal *bar*. This it is not; for no matter how suspicious the omission may be, it is for the court to leave the whole question of the reality of the alleged rape to the jury alone. But it is maintained that it is a salutary rule of policy, which juries should themselves enforce, in no case to sustain a prosecution for rape unless the prosecutrix's evidence is corroborated by the testimony of experienced persons, medical or otherwise, who were called in to inspect her person as soon after the occurrence as the circumstances of the case would allow. And such seems to be the case in England, where the courts agree in telling the jury that, unless there be positive medical evidence of some sort of violence to the person, there is not sufficient proof of penetration to constitute the offence.(*f*)

The nature and character of the testimony so to be obtained have been already discussed. Under this head it is enough to say that in all cases the results of, as well as the fact of, an examination are admissible evidence. It is admissible, also, for the prosecutrix to prove that she made a complaint, though she cannot put in evidence what were the particulars of her statement.(*g*)

§ 280. 4th. *Extent to which coition was carried.*—The English law, as to the extent to which the act must have been consummated, has undergone much fluctuation. Thus it was at first held that *emission* must be proved. Great difficulty was

(*f*) R. *v.* Gammon, 5 C. & P. 321. See *ante*, § 267.

(*g*) Wharton's C. L. § 1150. See Lacy *v.* State, 45 Ala. 80.

thus produced, which was obviated by the statute of 9 Geo. IV. c. 31, which dispensed with proof of emission. Then the question arose as to the *degree* to which penetration must be shown to have taken place. In Ireland it was said, somewhat loosely, by Lord Carlton, C. J., in 1800,(*h*) that it was enough if the prosecutrix swore to "carnal knowledge of her person." But in England it has always been held that the entrance of the private parts of the man within the private parts of the woman must be specifically proved. The first case tried on this point laid down a rule which, though once or twice subsequently departed from, may now be considered as the settled law, viz., that, though it is not necessary to prove the *hymen* to have been ruptured, yet the evidence of penetration must be positive.(*i*) The only point in which this rule has fluctuated has been in respect to the necessity of a rupture of the *hymen*. Thus, in 1832, in a case before Mr. Baron GURNEY, that learned judge said, that, "if the hymen is not ruptured, there is not a sufficient penetration to constitute the offence."(*j*) In 1839, however, Chief Justice TINDAL declared the only question for the jury to be, whether the private parts of the man did or did not enter into the person of the woman; and that, therefore, though it appear from the evidence, beyond all possibility of doubt, that the party was disturbed immediately after penetration, and before the completion of his purpose, yet he must be found guilty of having committed the complete offence of rape.(*k*) In the same year a boy named John Jordan was indicted for carnally knowing a girl under ten years; and, there being no evidence of a rupture of the hymen, it was insisted by the prisoner's counsel, on the authority of Gammon's case, just cited, that the offence had not been completed. The defendant was acquitted on other grounds; but Mr. Justice WILLIAMS told the jury, "I am of opinion, as matter of law, that it is not essential that the hymen should be ruptured. In the case of Rex *v.* Gammon it was proved that

(*h*) R. *v.* Lidwell, 1 McNally's Evid. 606.
(*i*) R. *v.* Russen, 1 East, P. C. 438, 439.
(*j*) R. *v.* Gammon, 5 C. & P. 321.
(*k*) R. *v.* Allen, 9 C. & P. 31.

the hymen was ruptured, and the point was, therefore, not necessary to the decision of that case. I also think that it is impossible to lay down any express rule as to what constitutes penetration. All I can say is, that the parts of the male must be inserted in those of the female, but I cannot suggest any rule as to the extent."(*l*)

§ 281. Shortly previous to this, though not reported until afterwards, was a trial before Mr. Justice BOSANQUET, in which Mr. Justice COLERIDGE and Mr. Justice COLTMAN concurred with that learned judge in saying that it "is not necessary, in order to complete the offence, that the hymen should be ruptured; but that, where that which is so very near the entrance has not been ruptured, it is very difficult to come to the conclusion that there has been penetration so as to sustain a charge of rape." In consequence of this charge, the defendant was acquitted of the rape, and convicted of the assault, although there was evidence from the surgeon who attended the injured party that her private parts internally were very much inflamed, but that, in consequence, he could not tell whether the hymen was ruptured or not.(*m*) In 1841, however, the question was put to rest by a case which came before the twelve judges, in which the early decision of R. *v.* Russen was finally reviewed and sustained. The prisoner was charged with having feloniously ravished Mary Ann Wesley; and it was very clearly proved by her—she being a girl between eleven and twelve years of age—as well as by a woman who detected the prisoner in the act, that carnal intercourse had been attempted. With respect to penetration, a surgeon was called, who deposed to the appearances in and about the child's private parts, and stated his belief that penetration had taken place, but that the hymen, which in the prosecutrix was placed at the usual distance from the opening, had not been ruptured. The jury returned a verdict of guilty, finding "that there had been penetration, but that the penetration had not proceeded to the rupture of the hymen." On this finding the prisoner was sentenced, and the judgment sustained by all the judges.(*n*)

(*l*) R. *v.* Jordan, 9 C. & P. 118.
(*m*) R. *v.* M'Rue, 8 C. & P. 641.
(*n*) R. *v.* Hughes, 8 C. & P. 752.

In accordance with this result, in a case tried in 1844, where the surgeon deposed that "the hymen of the child was not ruptured, but that upon the hymen was a venereal sore, which must have arisen from actual contact with the virile member of a man," Mr. Baron PARKE left it to the jury to say "whether, at any time, any part of the virile member of the man was within the labia of the pudendum of the prosecutrix; for if ever it was (no matter how little), that will be sufficient to constitute a penetration, and the jury ought to convict the prisoner of the complete offence." The verdict was, not guilty.(*o*)

§ 282. In this country, the rule thus laid down—that there must be *some* entrance proved of the male within the female organ, but that neither rupture of the hymen nor emission need be proved—has been universally followed.(*p*) Perhaps the furthest limit to which it has reached is in a remarkable case in Philadelphia, where, though there was no medical examination, it was held that proof by the prosecutrix of pain in the sexual organ, and of the juxtaposition at the time of the defendant's face to her own—she at the time being in a dentist's chair, under the influence of ether—was enough to justify a jury in presuming that there was penetration, and that the penetration was sexual. The general result of both medical and legal opinion, however, is, that, while the learned and able judge who tried the case properly left it to the jury as a question of fact, as he was obliged to do, to determine whether penetration had taken place, the verdict was not sustained by the evidence, and forms an unsafe precedent for the future.(*q*)

In North Carolina, it was decided in 1860 that emission was necessary.(*r*) By the act of February 29, 1861, it was provided that "proof of penetration only" should establish the offence. Under this act it was held in 1871, that the slightest penetration, without rupture of the hymen, was enough.(*s*)

(*o*) R. *v.* Lines, 1 C. & K. 393.

(*p*) State *v.* Leblanc, 3 Brevard 339; Penns. *v.* Sullivan, Add. 143; Stroud *v.* Com., 11 S. & R. 177; Com. *v.* Thomas, 1 Virg. Cases 307. See Wh. C. L. § 1137.

(*q*) Com. *v.* Beale, Phil., 1854. See *ante*, § 245 *et seq.*

(*r*) State *v.* Gray, 8 Jones 180.

(*s*) State *v.* Hargrave, 65 N. Car. 467.

§ 283. In Ohio, in 1867, in a case of rape on a child seven years old, a physician testified that he found marks of violence and evidence of disease, but as a matter of science he had no means of determining whether the disease was *gonorrhœa* or *vaginitis*, the evidences of both diseases being indistinguishable. He then was permitted by the court to express his *opinion* to the jury that the disease was *gonorrhœa*, his opinion being founded mainly on the fact that he found evidences of that disease on the person charged with the rape. It was held by the Supreme Court that the expression of this opinion under such circumstances ought not to have been permitted.(*t*)

§ 284. Penetration may be inferred by circumstances, and may not be specially *eo nomine* proved.(*u*)

§ 285. 5th. *Want of age of defendant.*—There is an absolute rule, in this respect, at common law, viz., that an infant *under* fourteen is to be presumed positively incapable of committing a rape, though he may be convicted of an assault with an intent to ravish.(*v*) *Over* fourteen, this question resolves itself into the ordinary one of capacity.

§ 286. 6th. *Want of sexual capacity of defendant.*—This is purely a medical question, which has been examined under another head.(*w*)

(*t*) Moore *v.* State, 17 Ohio St. 521.

(*u*) Brauer *v.* State, 25 Wisc. 413. See R. *v* Lines, 1 C. & K. 393; State *v.* Farr, 28 Iowa 397.

(*v*) Wh. C. L., § 1134, and also *ante*, § 210.

(*w*) *Ante*, § 201.

BOOK IV.

QUESTIONS RELATIVE TO IDENTITY.

ANALYTICAL TABLE.

CHAPTER I.

IDENTIFICATION OF THE LIVING OR DEAD.

1st. CASES OF DOUBTFUL IDENTITY, § 287.
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- (4) Fractures, deformities, and peculiarities in the dead body, § 298.
- (5) Cicatrices, § 300.
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  - (*a*) Heat as influencing decomposition, § 305.
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- (8) Putrefaction in the fœtus, § 319.
- (9) Influence of lime on the putrefactive process, § 320.

§ 287. 1st. *Cases of doubtful identity.*—Many curious cases of doubtful or disputed identity might be cited to illustrate the singular fortuitous resemblance between individuals, not only in their general personal appearance, but also in accidental marks. Other cases also might be related, in which long absence and various circumstances have so changed a person, that his nearest relatives have not been able to recognize him. Usually, in cases of disputed identity, whether of the dead or living, a scar, a deformity, or some congenital or indelible

mark, as a nævus maternus, or mother's mark, a mole, tattooing, etc., has proved the only means of recognition.

Salomé Muller sued for her liberty before the courts of Louisiana, alleging that she was a white woman, and had come over from Germany with her parents, at the age of three years. Since that time she had been held in slavery. She was recognized by her resemblance to her family, and further identified by the existence of two small *nævi materni* upon the inside of each thigh, which were correctly described by the midwife who assisted at her birth, and the woman who took care of her upon the Atlantic passage, after the death of her mother.(a)

Even more remarkable is the conflict as to identity in the Tichborne case, in which, after a trial of weeks, the plaintiff, who sued as Sir Roger Tichborne, claiming as such possession to large English estates, broke down in his case, and a verdict was taken against him without hearing the defendants. An indictment was then found against him for perjury, but, as this has not yet (1872) been tried, comments are reserved to a future edition.

§ 288. Usually, medical testimony can hardly be required respecting the identity of the living. In disputed cases, it may become necessary for the physician to give his opinion respecting the permanence of scars, tattoo marks, and congenital or acquired deformities. But more frequently he is called upon to assist in the identification of the dead, or to state after how long a period of time and under what circumstances such identification is possible. Krügelstein says that he assisted at the inquest upon the body of a man found dead in a morass. The body was recognized by a number of persons present, as well as by the wife of the deceased, who, however, remarked that her husband when he had left her wore a different jacket from the one on the body. Some time afterwards, however, the man who was supposed to have been dead came home again, and upon investigation it was finally discovered that the deceased was a person belonging to a neigh-

(a) Beck, vol. ii. p. 664, from the Monthly Law Reporter, Boston, 1845, Wh. C. L. (2d ed.) 337; and see article in Albany Law Journal for Sept. 28, 1872, p. 239.

boring village, who had left his home at an early age, and upon his return was recognized by no one. The likeness between the two men, it is stated, was most extraordinary.(*b*) Dr. Kinlock, of Drumoak, Aberdeenshire, relates a case of mistaken identity under extraordinary circumstances. The body of a man between sixty and seventy years of age, was found slightly imbedded in sand, on the bank of a river; both eyes had been picked out by hooded crows, but decomposition had made no progress. The left ear and the first finger of the left hand were wanting, having the appearance of having been lost in early life. The body was conveyed to a suitable place, and persons were requested by advertisements to come and identify it. After some time, two young women claimed it as the body of their father, who, they stated, was a lawyer; that he was in the habit of leaving home for two or three weeks at a time, without informing them where he went, and that he had lost the left ear, and first finger of his left hand. They apparently recognized the clothes and the body, and gave vent to expressions of grief on the event. Subsequent doubts in the mind of one sister were overruled by the confident affirmations of the other. The funeral took place accordingly, and was attended by the daughters and friends of the supposed deceased lawyer. Returning from the funeral, the boatman of the ferry which they had to cross asked them for whom they were in mourning, and, upon receiving their answer, laughingly informed them that he had, only half an hour before, ferried their father over alive and well, and directed them where they would find him. This, to their great joy, proved true. Whose was the body they had buried in the churchyard at Drumoak remained undiscovered.(*c*)

(*b*) Henke's Zeitschrift, 1850, 4 H.

(*c*) Ed. Monthly Journ., Feb. 1854. The following curious case occurred in Boston: It was said that, upon the testimony of the captain of a vessel and six of his crew, a man named James Guard had been arrested by the police on the charge of attempting to rob a vessel, but was afterwards released on its appearing that he could not be the man, as on the night of the robbery he was safely slumbering in the watchhouse of the North End, whither he had repaired for lodging. It was also stated, that on Monday night a body was found in the water at the end of Commercial Wharf, which an officer of the north station testified before a coroner's jury was the body of the unfortunate

Cases might be indefinitely multiplied by citations from the annals of criminal procedure, to show that nothing is more common than the failure of the nearest friends to identify the body of a deceased person, or than the most positive judicial testimony in regard to the identity of persons found dead, but which subsequent events have proved to be utterly erroneous.

§ 289. 2d. *Means of identification.*—The means of recognizing from the skeleton the age of the deceased, are found chiefly in an observation of the degree of ossification. A brief description of this process at different ages up to the time at which it is completed, will enable us to determine the question in an appropriate manner. One of the most reliable indications of age in the skeleton of a supposed new-born child, will be found in the osseous point in the cartilaginous epiphysis of the lower extremity of the femur. Its importance in this relation was first pointed out by Beclard, but has lately been further substantiated by the observations of Ollivier and Mildner.(*d*) At

James Guard, who, but a night previous, had been so falsely charged with crime, but who, nevertheless, appeared to have rather suddenly come to a tragic end.

The coroner's jury had no doubt, from the testimony of the officer, that the body was really that of James Guard, and they returned a verdict in accordance thereto, stating that "James Guard came to his death by accidental drowning." Thus the matter was deemed and considered to be settled, when —so runs the report—last night, as the aforesaid officer sat meditating in his office, at the station house, upon matters connected, no doubt, with the city's welfare, the door slowly opened, and what appeared to be the body of James Guard entered. In these days, a police officer is not apt to be a believer in ghosts, but, for a moment, thoughts of that character flitted through his brain. A request for lodgings, uttered in no ghostly tones, awakened him to a sense of reality, and an explanation ensued, when it appeared that James Guard, who had been once charged with robbery, and on the oath of a coroner's jury with having been picked up drowned, was in reality alive and kicking, with sufficient love of the things of this world to receive with gratitude the gift of a soup ticket, presented to him by the penitent police officer. Thus the body now lying in the dead-house is not that of James Guard, but of some one who so closely resembled him as to have been mistaken for him by a dozen persons. It is probably fortunate for the living, that this "Dromio," who might have continued to work mischief for him, has really deceased. It is, certainly, a strong case of personal resemblance. (Boston Law Reporter, vol. viii. No. 1, page 55, etc.)

(*d*) Prag. Vierteljahrschrift, 4, 1850.

mmencement of the last month of intra-uterine existence, may be seen, upon a transverse section of this epiphysis, which is more vascular and darker than the surrounding ıre, in the midst of which a body of the size of a poppy the head of a fly may be recognized, which, upon drying, found to be of newly formed bony matter. At the time h, this osseous point has attained the size of a pea or is hollow and incloses a porous and vascular substance; ll itself being of a firm, bony nature. From the obser- of the above-mentioned authors, it results that, 1st. osseous point be wanting, the skeleton is that of a fœtus more than eight months; 2d. When it has attained the a poppy seed or the head of a fly, the fœtus is probably last month of gestation; 3d. When it has acquired a ter of one and a quarter lines, the full period has been d; and, 4th. If the point of ossification be three lines, re, it may be assumed that the child has lived after its These statements have been verified by their authors, is needless to say, that, having so important a bearing uestions of infanticide, as well as upon other questions s vital in their character, much additional confirmation ired to entitle them to our unreserved confidence.

0. The length of the skeleton of a new-born, mature s between fifteen and sixteen inches. At the end of the ar, the two sides of the frontal bone are united in half ength, the fontanelles diminish in size, the temporal s still composed of four pieces, and the four incisor ıave appeared. •Points of ossification are found in the d process of the scapula, in the ensiform cartilage, and patella. At the end of the *second* year, the length is thirty-two inches; the four portions of the temporal orm but one piece; the anterior fontanelle is usually and both halves of the os frontis are united. Two and four molar teeth have made their appearance. The bones, which are afterwards consolidated in the aceta-, touch each other; the epiphyses of the metatarsal and ırpal bones are ossified, and points of ossification are the lower end of the tibia and fibula. At the expira- the *third* year, the sutures of the bones of the head have a

zigzag appearance; all the first set of teeth are fully extruded; the odontoid process of the second vertebra is firmly united with the body; the spinous processes of the vertebræ ossify, as do the trochanter major, the patella, and the cuneiform bones. At the end of the *fourth* year, the child is about three feet long, the styloid process of temporal bone is formed, and the process of ossification continues in the parts mentioned. In the *fifth* and *sixth* year, no further trace of the division of the os frontis is found; the sutures unite, the arches of the vertebræ become united with the bodies and the lower extremity of the ulna, and the pisiform bones are ossified. In the *seventh* and *eighth* year, the second set of teeth replace the first. If the eight permanent incisors are present, the age is probably at least nine years. The canine and molar teeth make their appearance between the *tenth* and *twelfth* year, with the exception of the last molar, which is very irregular in the period of its extrusion. Orfila describes the ossification at this period as follows: At *eight* years, the upper extremity of the radius; at *nine*, the navicular bone of the carpus; at *twelve*, the trochlea of the os humeri; from *thirteen* to *fourteen*, the trochanter minor and the three parts of the os innominatum, which last is sometimes delayed till the fifteenth year; and at *fifteen*, the sacral vertebræ, are united together. From this period up to the age of twenty-five, the same author observes that the process of ossification is most noticeable in the following points: from *fifteen* to *sixteen*, the coracoid process of the scapula is united with the body of the bone, and the acromion contains an ossific point; from *fifteen* to *eighteen*, an osseous point in the sternal end of the clavicle; from *fifteen* to *twenty*, ossification of the last bone of the coccyx. At *sixteen* years, an osseous point is seen in the head and tubercles of the ribs; at *seventeen*, bony union of the epiphyses of the phalanges; and at *eighteen*, of the head and trochanter of the femur. From *eighteen* to *twenty-five*, union of the sphenoid and occipital bone of the three parts of the tibia; and from *twenty* to *twenty-five*, of the first piece of the sternum to the rest of the bone. Between *twenty-five* and *thirty* years, occurs the complete union of the first to the second bone of the sacrum; from *forty to fifty*, of the ensiform cartilage to the lower extremity of the

sternum; and between this and the *sixtieth* year, the union of the sacrum and coccyx. In advanced life, the bones lose their density; the earthy matter predominates, and they hence become more brittle. According to Sömmering, they lose nearly a fourth part of their weight. They are yellower than in the previous years of life; the diploë in the flat bones disappears, so that the two plates of bone touch each other, are thin and sometimes lose their substance in this part, forming an opening. The sutures in the bones of the skull become indistinct, and generally first on the inside of the cranium. The intervertebral substance loses its thickness, and the borders of the cervical vertebræ are smaller before than behind. If the teeth have been lost, the alveolar processes become absorbed, but if they remain, they bear unmistakable signs of age in their yellow color and worn appearance. The ensiform cartilage is completely ossified, as well as those of the ribs. There are, however, no such alterations in the condition of the skeleton as would give more than an approximate appreciation of the exact age at this period of life.(*e*)

§ 291. *Stature.*—When the whole skeleton has been preserved, and the articulating ends of the long bones have not been wasted by decay, the height of the individual can be obtained by adding from one and a half to two inches to the length of the skeleton. Should, however, the bony remains be in a fragmentary condition, an accurate estimate of the height of the living person cannot be made. Orfila and Sue have, indeed, by assuming the superior border of the pubes to form the exact centre of the body (as it should do in a well-formed adult), considered it possible to calculate the height. The tables prepared by M. Orfila comprise, moreover, measurements of the several cylindrical bones, from which he proposes to calculate the stature of the skeleton and of the living body.(*f*) Dr. Guy has found, however, upon a careful examination of these tables, that they cannot be relied upon as

(*e*) The foregoing statements have been taken chiefly from the works of Mendé, Nicholai, and Friedreich, who have devoted particular attention to the subject; also from Dr. J. Miller, Das Knochengerüste des Menschen, etc., in Henke's Zeitschrift for 1852, 3 H. p. 62.

(*f*) Traité de Méd. Lég., 4th ed.

accurate, since in one instance the upper half of the body exceeded in length the lower by five and a half inches, and in another the excess was six inches in a contrary direction. By taking the average of all the measurements, this author states that we may be in error to the extent of two and a quarter inches; and in the table of the measurements of the cylindrical bones we may be led into error in calculating from them the height of the skeleton, to the extent of more than four inches, and in no case of less than one and three-quarter inches.(*g*) Hence, owing to the false inferences (which occasionally may be of serious importance) to which these calculations may lead, the physician should use great reserve in giving an opinion as to the stature of the body, from the inspection of merely a portion of the skeleton.

§ 292. (2) *Teeth.*—The most striking part of the evidence by which the identification of the remains of the murdered Dr. Parkman was secured was that given by the dentist, Dr. Keep. He testified that about three years previously he had made and fitted a set of teeth for Dr. Parkman, a set for each jaw, consisting of manufactured artificial teeth, formed in combinations of three blocks to each jaw, and set upon gold plates fitted and adjusted thereto. He stated that several natural teeth and stumps remained, to which, as well as to the natural shape and peculiarities of the jaws, it was necessary that the plates should be adjusted. An attempt having been made to consume the head by fire, in an assay furnace, the gold had melted away, but the mineral teeth, being composed of an infusible material, remained, preserving more or less of their original shape. Dr. Keep recognized the blocks of mineral teeth as of his own manufacture, and as having been made for Dr. P., and showed that they could have belonged to no one else, from their correspondence with the trial-plate and the mould of the jaw of the deceased, which had been carefully preserved and marked with his name. In addition, the lower jaw had a certain peculiarity of natural formation which served to distinguish it from others, and render the correspond-

(*g*) Forensic Medicine, p. 24.

ence of the block of mineral teeth with it more significant than it might otherwise have been.

§ 293. Dr. Guy states that a doubtful case of identity, in Edinburgh, was decided by a dentist, who produced a cast of the gums which he had taken before death. So also the remains of the Marchioness of Salisbury, discovered among the ruins of Hatfield House, were identified by the jaw-bone having gold appendages for artificial teeth.(*h*)

§ 294. In Mr. Sargent's history of Braddock's expedition(*i*) is narrated a very interesting instance of identification by means of an artificial tooth. Sir Peter Halket, in 1758, after the reduction of Fort Du Quesne, proceeded to the spot of Braddock's defeat for the purpose of discovering, if possible, the remains of his father, who was there killed. "In reply to his anxious questions," we are told, "one of his tawny guides had already told Halket that he recollected, during the combat, to have seen an officer fall beneath such a remarkable tree as he should have no difficulty in recognizing; and, at the same moment, another, rushing to his side, was instantly shot down, and fell across his comrade's body. As they drew near the spot, the detachment was halted, and the Indians peered about through the trees to recall their memories of the scene. With speaking gesture, they briefly discoursed in their own tongue. Suddenly, and with a shrill cry, the Indian of whom we have spoken sprang to the well-remembered tree. While the troops rested on their arms in a circle around, he and his companions searched among the thick fallen leaves. In a moment, two gaunt skeletons were exposed lying together, the one upon the other, as they had died. The hand that tore away their scalps had not disturbed their position; but no sign remained to distinguish the relics from the hundred others that strewed the ground. At the moment, Sir Peter remembered him of a peculiar artificial tooth which his father bore. The bones were then separated, and an examination of those which lay undermost at once solved all doubts—'It is my father!' exclaimed the unhappy youth, as he sunk into the arms of his scarce less affected friends."

(*h*) Guy's Forensic Medicine, p. 23.

(*i*) Philada., 1850, p. 277.

§ 295. A most singular case of disputed identity, in which there was between two persons such a similarity of name, time, place, age, occupation, and circumstances, as for a long time utterly to perplex the investigation, occurred in London. The body of a woman supposed to have been murdered was missing, and another woman was arrested upon suspicion of having secretly made way with her and sold her remains for dissection. Both direct and circumstantial evidence brought the crime home to her. The day after the alleged murder, an old woman, of the description of the supposed deceased, was found with a fractured thigh, lying exhausted in the streets. She gave her name as Caroline Walsh, and said that she was from Ireland. She died, and was buried at the London Hospital. The name of the missing woman was also Caroline Walsh, and she was also Irish. The prisoner, Elizabeth Ross, when arrested, insisted that this was the female whom she was accused of having murdered. Various points of difference were established by the evidence of a large number of witnesses, but the chief distinction was, that, while it was stated that the missing woman had very perfect incisor teeth (a remarkable circumstance for her age, which was eighty-four), the other one, who died at the Hospital, had no front teeth, and the alveolar cavities corresponding to them had been obliterated for a considerable time. Moreover, the non-identity was further confirmed by the granddaughters of the missing woman, who swore that the exhumed body of Caroline Walsh was not that of their grandmother.

§ 296. (3) *Sex.*—The determination of sex from an inspection of the skeleton is seldom attended with much difficulty, and even when but a few of the bones remain it is sometimes possible to give a positive opinion relative to the sex of the deceased person. The general osseous development is greater in man than in woman; in two persons of equal weight, of the two sexes, the proportion is, according to Autenrieth, as 8 : 10. The skull of the female is a little smaller than that of the male, while the facial portion is obviously shorter and smaller; hence the apparent disproportion between the cranium and the face in the female. Its bones are also thinner, the forehead is lower and narrower, the frontal sinuses and all the

foramina smaller, the orbits comparatively larger, and the buccal and nasal cavities less capacious than in man. The thorax is shorter and narrower than in the male, and the difference is particularly marked in the upper part; the clavicles are less bent, and the shoulders are lower and narrower, the arms and hands shorter, and the fingers more delicate and pointed. The bodies of the lumbar vertebræ are higher, and the invertebral substance thicker than in the male skeleton. The ribs are shorter, thinner, and flatter, and have sharper edges than in the male, and have also other peculiarities, which it is not necessary to dwell upon. The most striking difference, however, is in the pelvis; the hip-bones being more widely apart, and all the diameters of the true pelvis, both of its entrance, cavity, and outlet, being greater than in man; the sacrum is more concave, the upper border of the symphysis pubis is inclined more forward, and the arch of the pubis is wider. On account of the greater width of the pelvis the hip-joints are further apart than in the male, although the trochanters are smaller: the neck of the femur forms an angle of 120°–125° with the body of the bone, while in the male it is from 127°–135°; the femur is shorter, more bent, and directed obliquely inwards, and the tibia is also shorter, and the bones of the feet smaller and more delicate.(*j*)

Some of these differences are not so striking in the skeletons of females advanced in life, but the essential characters of the pelvic bones remain and are sufficient to indicate the sex.(*k*)

§ 298. (4) *Fractures, deformities, and peculiarities in the dead body.*—Dr. Taylor relates an instance in which the utility of evidence of this kind was shown. A gentleman was tried in

(*j*) Dr. Jno. Neill found, upon an examination of thirty-two skeletons, that the *thyroid foramen* in the *male* is *oval*, and in the *female* triangular. He also observed that the male foramen is longer and narrower, and that the long axis is nearly parallel to the rami of the pubes and ischium; whereas in the female, the foramen is not only smaller and triangular, but the apex of the triangle is downward, its internal side nearly parallel to the rami, and the base of the triangle is proportional to the chord of the arch of the pubes.—*Trans. Coll. Phys. of Phil.*, vol. iii. No. 2.

(*k*) Krause, Handbuch der Menschl. Anat. 2 Aufl., Bd. 1, p. 235.

India for the murder of a native. It was stated that the prisoner had struck the deceased, a few hours before his death, several blows upon the chest and had thereby broken his ribs. A skeleton was produced as being that of the dead man, and upon examination it was found that one of the ribs had been broken, but that it was united by a firm osseous callus. Hence the opinion was very properly given that the fracture could not have been caused a few hours before death, but must have taken place from another cause some time previously. The period at which callus is fully formed after a fracture depends somewhat upon the age and constitution of the individual; it is usually, however, several weeks before it is sufficiently firm to bear the weight of the body, when one of the long bones of the lower extremity has been broken. Gunshot and other penetrating wounds of the skull are generally identified by the form of the opening and the sharp and broken character of the edges. Sometimes a portion of the weapon or the ball is found in the head. The absorption of bone made by the pressure of a tumor is recognized by the loss of substance around the opening and its smooth and polished character, and the previous existence of necrosis can also be readily known by its diffusion around the orifice, and in other parts of the skull.

In 1814, portions of a human body, having been found floating in the Seine, were taken up and submitted to a medico-legal examination. The body was identified from the fact that disease of both hip-joints was found, which must necessarily have caused considerable deformity and lameness, since it was evidently of old standing, new cavities having been formed above the acetabula, in which the heads of the thigh-bones rested. The assassin was afterwards discovered.(*l*)

§ 299. In those cases in which certain portions only of the human body are found, or in which all appear to be present, though in a dissevered condition, the preliminary step to the identification depends necessarily upon the ability of the examiner to so adjust the parts together as to be certain that they naturally formed parts of one body. This has been suc-

(*l*) Briand, Méd. Lég., p. 586.

cessfully done in many remarkable cases, as in the one just quoted; in the case of Ramus, where the head was found in the Seine, the trunk in a sewer, and the legs near the Pont-Neuf; and in that of Dr. Parkman,(*m*) where the remains of the bones of the head were found in a furnace, and the thorax and limbs concealed in different localities. In the last case, the head having been almost entirely consumed, nothing remaining but a few fragments of bone, there could be no clue to identity from the features; but, it having been found that the other portions of the body could be adjusted to each other in such a manner as to prove that they had once constituted a whole, a presumption of identity was established from the computed stature, certain peculiarities of form, the presence of gray hair upon various portions of the body, and, finally, from the block of mineral teeth, which, as before stated, fitted the mould of the jaw of the deceased, as previously taken by a dentist.

§ 300. (5) *Cicatrices.*—The indelible marks upon the skin which are left by wounds, cutaneous diseases, and surgical operations, afford frequently valuable means of identification. The tissue of which the scar is formed is of a dense and fibrous nature, and it is distinguished from the surrounding skin by its whiter color, and the absence of hair and sebaceous follicles. When not distinct, it can often be brought out by friction, which reddens the adjoining skin, but does not affect the scar. Some have, however, a red or purplish color, especially those which are the result of eruptions depending upon a constitutional cause, as syphilis or scurvy. The *shape* presented by cicatrices is very various. A *linear* cicatrix is the result of a simple incised or punctured wound, which has healed by adhesion. But all incised wounds do not leave scars of this shape. They are sometimes curved or elliptical, owing to the retraction of the skin, or to the wound having been inflicted upon a convex surface. Whenever the injury has been attended with loss of substance, the healing process must necessarily take place by granulation, and the scar will be irregular

(*m*) Guy's Forensic Medicine, 3d edit., p. 24.

in shape. *Gunshot wounds*, when a bullet has been the projectile, leave a *round* and *sunken* scar, which is usually much smaller than the ball, if no efforts to dilate the wound have been made, and it is also adherent to the subjacent parts. If the shot has been fired close to the individual, the grains of powder will also sometimes penetrate the skin, and give it a tattooed appearance. A round scar is sometimes also left by a penetrating wound from a weapon with a rounded or triangular blade, but it has not the sunken appearance left by a gunshot wound. The cicatrix which results from the healing of a scrofulous or syphilitic sore has considerable similarity to that made by a ball. If the scar has resulted from a scrofulous abscess in the gland, the appearance of it is peculiar. Its shape is more angular than round; it is traversed by adherent bridles of skin, and is therefore uneven and fenestrated, although its surface is shining, smooth, and white. When it is seated on other parts of the cutaneous surface it is not so deep, except it has become adherent to a subjacent bone, and resembles in its smooth and enamelled surface very much that which is left by a burn. Those which are caused by *syphilitic* ulcerations are irregular in shape, are puckered, hard, often elevated, and more or less of a copper color. The position of these cicatrices will often, moreover, give a key to their origin, being usually seated over the lymphatic glands. The cicatrices resulting from burns are too familiar to need description.

§ 301. The question may arise as to the possibility of the *disappearance* of a scar. We believe that, as a general rule, all scars resulting from wounds and from cutaneous diseases, which involve any loss of substance, are indelible; the only exception that can be made being in regard to trifling punctured wounds, where but little violence has been done to the skin. Casper says,(*n*) "Scars occasioned by actual loss of substance, or by a wound healed by granulation, never disappear, and are always to be seen upon the body. But the scars of leech-bites, of lancet-wounds, or of cupping instruments may disappear after a lapse of time that cannot be more distinctly specified, and may therefore cease to be visible upon the body.

(*n*) Tor. Med., vol. i., p. 104.

It is extremely difficult or impossible to give any certain or positive opinion as to the age of a scar." *Tattoo* marks are also usually considered indelible. This is not the opinion of Dr. Casper, who in a trial at Berlin, where the question came up, stated, as the result of his inquiries made among the old soldiers at the invalid hospital in that city, that the marks of tattooing can disappear.(*o*) The evidence, however, was not, we think, of sufficiently precise a character to warrant this statement. "Out of 36 examples, the marks had become faint with time in 3, were partially effaced in 2, and completely obliterated in 4." Hence, for the actual previous existence of these last he had to depend upon the word of the person whom he examined. Moreover, the age and the substance with which the operation was effected are not reported. No doubt the pigment used is often partly absorbed, since the lymphatic vessels leading from the spot have been found filled with it, but better evidence of its complete disappearance is yet required before the well-established belief of the contrary can be shaken.

§ 302. Hutin(*o*[1]) has confirmed the opinions expressed by Casper, and Tardieu(*o*[2]) has also shown, by his investigations, that in a large number of cases, more especially those in which cinnabar or blue ink has furnished the pigment, the marks may entirely disappear, so that we transcribe without hesitation Casper's dogma, "that tattoo marks may become perfectly effaced during life; that in not a few cases they disappear, so that they are no longer visible on that body when dead, on which during life witnesses had often seen them, and that their existence at a former period may possibly be ascertained by an examination of the neighboring lymphatic glands."(*o*[3])

§ 303. (6) *Hair.*—A curious case, illustrating the possibility of a fraudulent decolorization of the hair interfering with the identification of a person, is reported by Orfila.

(*o*) Casper's Vierteljahrschrift, 1852, 1 Bd. 2 Heft (Der Process *Schall* eine *cause célèbre*); and see the conflicting evidences in this case in the Tichborne case, 1872.

(*o*[1]) Récherches sur les tatouages, Paris, 1853–8.

(*o*[2]) Ann. d'Hygiène publique, Janv. 1855, p. 175 et seq.

(*o*[3]) Casper's For. Med., vol. i. p. 109.

A man named Benoit was arrested on suspicion of murder. Some witnesses testified that they had seen him in Paris at two in the afternoon with black hair, while others declared that *they* saw him at Versailles, with fair hair, at five or six in the evening of the same day. The question being proposed whether it was possible to change the color of the hair from dark to light, Orfila deposed that it was. He made numerous experiments to show this, from which it resulted, that by washing the hair with solutions of chlorine, black hair could be changed to various lighter shades, according to the strength of the solution, and the length of time it remained applied. This mode of decolorization can, however, readily be detected by the peculiar smell of the chlorine, and by there being something unnatural in the color resulting from its application. He found also that the most effectual way to darken hair naturally light was by the employment of a compound of litharge, chalk, and fresh lime in nearly equal parts. After the hair which has been wetted with a solution of these materials has become dry, the chalk and oxide of lead remaining attached to the hair are removed by weak acetic acid, and cleaned with the yolk of an egg. The hair is thus effectually dyed black, without any injury to its texture. The fraud can, however, easily be detected by steeping some of the hair in dilute nitric acid, which dissolves the ingredients with effervescence, and, on testing the solution with hydrosulphuric acid, the black sulphide of lead will be obtained. Such cases can, however, very seldom come before courts of justice, this being, as far as we know, the only instance in which, since the ancient union of the functions of the barber and the surgeon, they have been again combined.

The color and peculiarities of the hair may undoubtedly, in many cases, assist in the inentification of the dead, but it is not unimportant to remember that in those cases where the body has been exposed to the vicissitudes of the weather for some time after death, the hair becomes bleached by the exposure, and thus hair which was really dark during the lifetime of the deceased may present a tawny appearance.

§ 304. (7) *The length of time which has elapsed since death*, as ascertained from an inspection of the remains of the human

body, can seldom be known with great precision, and in many cases, especially at a late period in the process of decomposition, many errors may be committed. The rapidity of this process depends upon a great variety of circumstances, and the influence of these it is therefore of some importance to consider.

The age and constitution of the person, his last sickness and mode of death, the existence of wounds, the length of time the body has remained exposed to the air before interment, and the temperature and hygrometric condition of the air at this time, the nature and depth of the ground, if the burial has taken place, and, if not, the nature of the medium in which the body has remained, and many other causes which it is here needless to particularize, must all be carefully considered in any estimate of the time that has elapsed since death.

§ 305. (*a*) *Heat*, especially when accompanied with humidity, is a powerful accelerating cause of putrefaction. Dry heat, if the temperature is elevated, does not promote it. Thus, the bodies of those that have perished in the caravans that traverse the African deserts, are often found in a dry and mummy-like condition. Even in temperate climates corpses interred in very dry vaults, as in the Catacombs at Rome, the leaden vaults of Bremen, the convent of the Capuchins at Toulouse, a church at Bordeaux, etc., remain in a tolerably perfect condition, very much resembling the Egyptian mummies.

§ 306. The following case illustrates the present topic, and affords a striking illustration of the important aid which justice may receive from science. In March, 1850, a workman engaged in repairing a Rumford fireplace found, in the hot-air chamber, the body of an infant which had been introduced through an opening made by the removal of two bricks. The body was mummified. During the preceding years four tenants had successively occupied the apartment. On examining the remains, M. Bergeret, to whom this duty had been judicially assigned, found within them a large number of bodies as large as a grain of wheat, dry, friable, open at either end, and of a mahogany color. These were the shells of the nymphs which produced the insects, the larvæ of which had devoured nearly all the abdominal organs. These nymphs were found

in great numbers about the mouth and neck of the body. The interior of the limbs was filled with larvæ, or maggots. Now the succession of these transformations is as follows: The female fly lays her eggs, from which in due time the larva, or maggot, issues, and is after a time transformed into a nymph, or chrysalis, which is inclosed in a sort of case or shell, and from which the perfect insect ultimately escapes. A year is necessary for these metamorphoses. The eggs are laid in the summer and their changes result in the reproduction of the insects at the commencement of the following summer. Now the eggs which produced the larvæ found in the body in March, 1850, must have been deposited in the summer of 1849. But the body also contained a number of empty nymph cases which must in their turn have been preceded by larvæ produced by eggs laid in 1848. Hence it was concluded that the death of the child had taken place in the summer of 1848, and consequently that no suspicion could attach to the persons who had occupied the room since that date. The inquiry having thus received a definite direction, a female who lived there apart from her husband, at the time indicated, was arrested, and a variety of circumstantial evidence rendered it certain that she had been pregnant and delivered of a child about that time. She was, however, acquitted of the charge of infanticide, on the presumed ground that there was no proof that her child had not died a natural death.(*o*[4])

§ 307. In very cold climates, bodies may be preserved for a long time. This is the case in some parts of Norway, where persons dying in the winter are not interred until the spring, the ground being frozen too hard to permit burial, and the corpse is preserved uninjured for several months. The body of Prince Menschikoff, banished to Siberia by Peter the Great, was found ninety-two years afterwards entirely unchanged. In the beginning of this century, the thawing of large masses of ice on the banks of the Lena left exposed the body of a mammoth, which was in such a state of preservation, that the flesh was eagerly devoured by dogs, bears, wolves, etc. The corpses which are preserved at the hospice on the top of Mount

(*o*[4]) Annales d'Hygiène, 2ème sér. iv. 442.

St. Bernard, where the thermometer stands nearly the whole year round below the freezing point, are perfectly recognizable after the lapse of several years.(*p*)

(*p*) There is upon the summit of the great St. Bernard, a sort of morgue (*dead-house*), in which have been deposited, from time immemorial, the bodies of those unfortunate persons who have perished upon this mountain by cold, or the fall of avalanches. The study of the circumstances of locality and of temperature in which this establishment is placed, may, to a certain degree, indicate the most favorable conditions for the long preservation of bodies. Thus are shown to travellers, bodies, which they assert have been sufficiently well preserved to be recognizable after the lapse of two or three years. A physician, whose position as former Prosector of the Faculty of Medicine of Paris rendered him curious to visit this part of the hospital in all its details, verified, with his own eyes, all that travellers have written, and has transmitted to us the following observations:—

"The hospital of St. Bernard is, as is well known, the most elevated habitation of Europe, being 7200 feet above the level of the sea. The temperature of this part of the globe is always very low, rarely above zero, even during summer. This extensive establishment is built upon the borders of a lake, at the bottom of a gorge in the mountain; the principal mass of the building represents a long parallelogram, placed in the direction of the gorge, so that its two principal faces, pierced with numerous windows, are sheltered from the wind by the rocks; whilst the two extremities, on the contrary, are exposed to all the violence of those which blow from one side of the gorge to the other. About fifty steps beyond the principal building, and a little out of a right line with it, is situated the morgue, a sort of square chamber, the walls of which are three or four feet thick, constructed of good stone, and the arched roof of which is very solid. Two windows, about four feet square, are pierced in the direction of the breadth of the valley, directly facing each other, so that a perpetual current of cool air traverses the interior of the chamber. There is, further, but a single table in this morgue, upon which they place the bodies when first introduced; after a while they are arranged around the walls in an upright attitude. At the time of my passage of the Great Saint Bernard (31st August, 1837), there were several of these mummified bodies along the walls of the chamber, but a greater number were entirely divested of flesh, and lie scattered about the earthy floor of the room. They informed me that decomposition only took place when the bodies fell by accident to the ground, which was owing to the humidity occasioned by the snows, which occasionally entered with the currents of air through the windows of the morgue."

Dr. Harlan says: "Early in September, 1833, I had an opportunity of inspecting the contents of the morgue of Saint Bernard. Among the group of bodies of every age and sex, we were particularly struck with two figures, one, that of a man, whose countenance was horribly contorted by the act of desiccation; each limb and every muscle of the body had assumed the expression of a wretch in purgatory. The other was that of a mother holding

§ 308. (*b*) The *air*, at its ordinary temperature, favors the progress of putrefaction. In bodies which are exposed for a long time to all the changes of weather, it is estimated that all the soft parts are completely destroyed in less than six years, and most of the bones in twelve, as they become light, brittle, and honeycombed in their appearance.

§ 309. (*c*) *Water*, being a natural constituent of the human body, is also one of the elements necessary for the progress of decomposition. If, however, the body be sunk in water, putrefaction does not advance so rapidly as in the air, and often the changes which take place are different from those of ordinary decomposition. The soft parts of the body may become converted into a substance called, by Chevreul, *adipocere*. It is solid, white, and fusible. The ammonia which results from the decomposition of the muscles, as well as a certain quantity of potash and lime, form a combination with the oleic and margaric acids of the fatty portions of the body. The bodies of children, and of stout, fat persons, undergo this change most readily. But the presence of considerable moisture is necessary for it, and it therefore occurs only in the water, or in moist soils, especially where many bodies are buried together. It is uncertain at what time this saponification takes place in the water: according to Devergie's observations, it is pretty complete in five months. In the ground, the process is much slower, requiring at least three years for a total transformation. A remarkable example of this change observed in New York is reported by Dr. Dalton.(p^1)

§ 310. (*d*) *Soil.*—The dryness or moisture of the *ground*, the depth at which the body is buried, and its more or less complete isolation from contact with the earth, are circumstances which modify the progress of putrefaction, and render any general opinion as to period of death inapplicable. The body

her infant to her bosom, the latter with an imploring expression, looking up to the face of the mother, whom it appeared to have survived some time, as is generally the case when mother and child are frozen together, a greater power of forming animal heat existing in children." (History of Embalming, etc., by J. N. Grannal. Translated from the French by R. Harlan, M.D. Philadelphia: Judah Dobson, 1840.)

(p^1) New York Journ. of Med., Nov. 1859, p. 375.

mpilius was preserved in a stone sarcophagus for
ries; and the bones of Dagobert, who died nearly
lred years ago, were found entire, having been
ooden coffin inclosed in a stone tomb. The bones
and Heloise were so well preserved, after a lapse
red years, that the female skeleton could be readi-
hed from the male.(*q*) On the other hand, the
ild buried in the earth has been found reduced to
nes in nine months; and that of a young man,
smallpox, in less than six.(*r*) In general, observa-
vn, that of the body of an adult, buried in an or-
, nothing at the end of twenty years will remain
ll and the thigh-bones, sometimes also the arm-
Schürmayer states, that in general, in churchyards,
not exceed fifteen years. In order to show, how-
tle dependence can be placed upon the uniformity
nges, the following case will serve as an example.
vas found, in digging the cellar under an old house.
rose whether the individual to whom it belonged
ore than twenty years before. Soon afterwards,
ns were found near by; and finally, an investiga-
been set on foot, the fact was clearly made out
of the old house had formerly been a burial place,
skeleton was at least 200 years old.(*s*)

sper gives the following valuable rule, which,
wn experience as a criterion, he thinks will not be
exact truth. "At a tolerably similar average
the degree of putrefaction present in a body, after
open air for one week (month), corresponds to
n a body after lying in the water for two weeks
after lying in the earth in the usual manner for
(months)."(*s*[1])

e following general results have been obtained by
e celebrated treatise, *Sur les Exhumations juri-*

ach, Geschichte u. Beschreibung der Knochen, etc., Göttin-

er, Knochengerüste des Menschen, etc., Henke's Zeitschrift,

te.

(*s*[1]) For. Med., vol. i. p. 37.

diques, contains nearly all that is accurately known on this subject:—

1. Putrefaction is, under equal conditions, more rapid in manure than in water, privy soil, or the ground.

2. In privy soil it is not so rapid as in water, but more so than in the earth.

3. Water, especially when frequently renewed, accelerates decomposition next in rapidity to manure.

§ 313. Dr. Walter Lewis, who was engaged for many months in the years 1849 and 1850, in inspecting the vaults of the churches of London for the General Board of Health, states, among many other interesting facts, which are not here in place, the following, relative to the time for decomposition in vaults: "The complete decomposition of a corpse, and its resolution into its ultimate elements, is by no means accomplished in a period of ten years; nor is that description accurate which represents, that at the end of that period nothing 'but a few brittle bones are left in the else vacant shroud.' On the contrary, so extremely slow is the process, under the circumstances, that I have but rarely seen the remains in a leaden coffin, of any age, in the condition described. In a wooden coffin, the remains are found exactly in this state in a period of from two to five years. This period depends upon the quality of the wood, and the free access of the air to the coffin. But in leaden coffins, fifty, sixty, eighty, and even a hundred years, are required to accomplish this. I have opened a coffin in which the corpse had been placed for nearly a century, and the ammoniacal gas formed dense white fumes when brought into contact with hydrochloric acid gas, and was so powerful, that the head could not remain near it for more than a few seconds at a time. The putrefaction is, therefore, very much retarded by the corpse being placed in a leaden coffin."(*t*)

§ 314. In estimating the period that may have elapsed since the death of a person, it is very important to be acquainted with the fact that the process of putrefaction is not equally rapid in all of the organs, but that it invades them succes-

(*t*) Lancet, Aug. 9, 1851.

sively, and, for the most part, in a determinate order. There are tissues, says Casper,(*t*) which require from twenty to thirty times as long as others to become putrid, and the relative condition of certain internal organs in this respect affords a securer basis than that of the superficial parts for making a probable conjecture as to the period of death. This author presents the results of his observations, of which the following is a concise summary:—

§ 315. Of internal organs the trachea, with the *larynx*, is the first to undergo decomposition. Its lining membrane may be completely softened when greenish spots are only beginning to appear upon the surface of the abdomen. The *brain* of children within the year follows next in order. The *stomach* soon becomes putrid. The earliest traces of this change are visible in from four to six days, in the fundus of the organ, and consist of dirty reddish spots varying in size from mere specks to that of the palm of the hand, without regular shape or limits, and traversed by bluish venous streaks. The importance of this fact in cases of suspected poisoning is very evident. As time elapses the dirty red color diffuses isself and gradually changes to a grayish-black tint, and in the same proportion the softening of the submucous tissues proceeds. In no case, says Casper, have I met with a separation of the mucous from the muscular coat, such as follows the action of a caustic poison, and which could not be distinguished from the merely emphysematous disintegration of the mucous membrane produced by putrefaction alone. Putrefaction of the *intestines* follows that of the stomach and passes through the same stages. In the majority of cases the *spleen* is next in undergoing decomposition; but this depends upon its greater or less degree of soundness. It grows softer and softer, so that at last it may be readily broken down with the handle of the scalpel. Its color turns to a pale bluish-green.

§ 316. The *omentum* and *mesentery* resist change somewhat longer, especially if they contain but little fat. They then become dry and grayish-green in color. Usually the *liver* continues firm for some weeks after death. It changes more

(*t*) Handbuch der Ger. Med., i. 51.

rapidly in new-born infants than in adults. The alteration begins upon the convex surface with shining green spots, which gradually invade the whole organ and change its color to coal-black. The gall-bladder resists longer. Next in order of change is the *brain* of adults. It gradually contracts after death. Putrefaction begins at its base, giving the parts a pale greenish color, proceeding upwards, and from the cineritious to the medullary substance. In moderate weather the brain becomes soft in two or three weeks, but a month elapses before it is converted into the reddish paste into which the brain of infants so speedily turns. If air has access to it, these changes occur more rapidly.

§ 317. The preceding organs may be associated as quickly putrefying. The following are more slowly changed. Even after the stomach, intestines, liver, etc., are far gone in putrefaction, the *heart* appears fresh, and all its parts are recognizable. Gradually it softens, first in its internal muscles and then in its walls, becoming soft, greenish, and finally black. About the same time as the heart, but sometimes earlier, the *lungs* undergo decomposition. In bodies which externally are far advanced in putrefaction, the structure of these organs is commonly very evident. This remarkable slowness of putrefaction in the lungs proves how little practical foundation there is for the notion that in the bodies of new-born children, otherwise fresh, the floating of the lungs in water can be ascribed to decomposition of their substance. The first evidences of this change consist in small collections of air beneath the pleura from the size of a millet-seed to that of a bean. They may form on any part, but, as the process advances, they become more numerous, especially upon the posterior surface of the lungs. Notwithstanding the development of these vesicles the color of the organs is very slowly altered. As putrefaction advances they become darker, of a bottle-green and finally of a black color, and in the same degree the parenchyma grows soft and collapses. The *kidneys* putrefy still later, first assuming a chocolate color and then softening. But their granular structure is very long retained. The *bladder* does not begin to decay until complete putrefaction of all the above-mentioned organs has taken place.

§ 318. The *œsophagus* in this respect does not at all resemble the rest of the digestive canal, and it is found months after death moderately firm, and in color a dirty grayish-green, when no trace of stomach and intestines remains. As regards the *pancreas*, for a long time it remains of a dirty reddish color, and when it becomes decomposed the rest of the body must have utterly gone into putrefaction. The *diaphragm* is one of the parts which yields the latest to this process. It is true that within a few weeks after death it is spotted with green; but after the lapse of from four to six months its muscular can be distinguished from its tendinous portion. The larger *blood-vessels*, and the *arteries* especially, change very slowly. Devergie mentions a case, in which the aorta of the body exhumed fourteen months after burial was perfectly distinct. The *uterus* is, however, of all the organs the one which retains its form and texture the longest. When not another organ is in a condition suitable for examination, the uterus remains tolerably fresh and firm, of a dusky red color, and so well preserved that it may be cut and its interior examined. These statements are not less applicable to the female fœtus and newborn infant than to the adult. A case is related by Casper of a woman whose body was found in a privy well nine months after she had suddenly disappeared, reports having meanwhile become current that she had concealed herself or been murdered by a certain person, otherwise of good repute, to avoid the discovery of her pregnancy. Her remains were in the last stage of putrefaction, all except the uterus, which was of a light red color, hard when handled or cut, and presented all the characters of a virgin's womb.

§ 319. (8) *Putrefaction in the fœtus.*—The fœtus, dying within the uterus, undergoes a change which is different from the putrefactive process. The body is remarkably flaccid in all its parts, and if it have died previous to the fifth month, it will often, after having undergone a certain degree of maceration, wither, contract, and become hard, principally upon the surface, exactly as if it had been preserved in a weak saline solution. In the latter months, however, its tissues soften and lose their cohesion, the skin has a spotted appearance, and, when the cuticle is detached, has a brownish-red color. The abdomen

is usually bare of the cuticle, which is, however, easily detached from all parts of the body. The head lies flat in whatever position it may be placed, and all the joints are extremely relaxed. The umbilical cord is of a brownish-red color, and very flaccid. The cellular tissue is infiltrated with bloody serum, and the cavities of the body contain the same liquid. The viscera are disorganized, easily lacerated, and very loosely connected with each other; gas is developed in the lungs and liver, and the kidneys and uterus are usually better preserved than any other parts. The lungs are of a dark-brown color, and punctated with black blood. The odor is peculiar, but not that of putrefaction, unless the child has been born after a lingering labor, and air has had access to it. The child which dies immediately before birth will not, of course, present these appearances. When the fœtus has been retained a long while in the womb, it is said that it may be converted into adipocere. This is not unfrequently the case with extra-uterine fœtuses. There is no difference in the putrefaction of children born alive, from that of adults, except in the greater rapidity of its progress. In order to determine the length of time which may have elapsed since the birth of the child, with a view to its identification when it is found in a putrid condition, recourse must be had to the same sources for an opinion as those already indicated, viz., the locality, temperature, medium, etc., to which it has been exposed, or in which it has lain.

§ 320. (9) *Influence of lime upon the putrefactive process.*—The belief is a very general one, that lime has the property of hastening the process of decomposition, and it is usually with this view that it has been thrown upon human remains which are sought to be rapidly destroyed. A few years since, upon the trial of the Mannings, in London, for the murder of O'Connor, medical evidence to this effect was given; the advanced state of putrefaction in which the body was found being attributed to the action of the lime, and, in particular, the destruction of the brain, to the fact of this substance having penetrated through the wounds of the head, and thus exercised a direct action upon it. But more attentive observations and careful experiments have shown that it does not possess the property thus attributed to it. The following con-

clusions were drawn by Dr. Taylor, from some experiments made for the purpose of ascertaining the effects of lime on animal matter:—

1. Lime neither retards nor hastens decomposition in dead bodies, whether whole or in fragments.

2. It has, however, the effect of hindering the diffusion of noxious effluvia from the dead body, from its combination with carbonic acid, sulphuretted and phosphuretted hydrogen.

3. Lime is therefore one of the best, safest, and cheapest means of preventing the effluvia from dead bodies.

4. The belief, therefore, that it hastens the putrefactive process, is entirely groundless.(*u*) The experiments of Mr. John Davy (*v*) confirm these conclusions. He placed various structures of the bodies of animals in wide-mouthed vessels, and covered them with a paste of freshly prepared caustic lime; at the end of a month they were found perfectly well preserved, although somewhat softened. Even seven months afterwards, they were found nearly in the same condition. At the end of two years, certain changes had taken place. The membranous portions were soft and transparent, the muscular tissue was converted into adipocere but had no offensive smell, and the other structures were no longer recognizable. In other experiments of the same kind, it was found that the lime was destructive only to the hair, nails, and epidermis; and that in animal tissues which were already beginning to putrefy, the immersion in fresh lime destroyed all foul smell, and brought the process to a standstill. The green color which the muscular tissue receives from contact with lime, is ascribable to a chemical action of this substance upon the coloring matter of the blood contained in them.

A detailed account of the changes which take place in the body after death, will be found in Chapter XVI.

(*u*) Henke's Zeitschrift, 41, E. H. p. 294.
(*v*) Edinb. Month. Journ., Jan. 1850.

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CHAPTER I.

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§ 321. *Definition of poisons.*—Physicians generally understand by the word *poison* a substance having an inherent deleterious property, which renders it, when taken into the system, capable of destroying life. It is difficult, however, to give a definition to the term which will meet the signification attached to it by different classes of persons; for while, in common language, poisons are understood to be those articles only which are deadly in small doses—as strychnine, prussic acid, arsenic, etc.—the lawyer and the physician will unite in affixing to it a general meaning, similar to that which we have given above. Some substances are habitually classed as poisons which, according to the popular signification, would have a doubtful

claim to be so called, being fatal only in large doses; and every medical practitioner is aware that very many active remedial substances may, in an overdose, produce serious and fatal effects. Moreover, questions may arise as to the applicability of the term to substances which destroy life by mechanical irritation, such as powdered glass, etc. In order to avoid the evil of giving too wide or too restricted a meaning to the word "poison," we adopt this definition, which makes no reference to the quantity required to produce a poisonous result, nor to the mode in which it is introduced into the system.

§ 322. *Conversion of harmless substance.*—The *idiosyncrasy* which converts a harmless substance into a poisonous agent, is very frequently observed in the case of articles of food. Thus mussels, fish, pork, mushrooms, and mutton have frequently given rise to all the symptoms of irritant poisoning. It should be remembered, however, that the symptoms in these cases may result as well from the mechanical irritation of the food —too large a meal having been taken, or from the fact of its being in a condition unfit for use. The cases in which a really poisonous substance has been taken with impunity are more rare. In the majority, the immunity is only comparative, the person being affected merely in a less degree than is usual. An instance is, however, related, on the authority of Dr. Christison, in which a gentleman, unaccustomed to the use of opium, took nearly an ounce of good landanum without any effect. Dr. Hartshorne says, that a medical friend of his had "lately seen a man in this city swallow about five grains of corrosive sublimate, and was informed by the apothecary at whose shop he witnessed the act, that the individual in question was in the habit of taking the same quantity every day."

§ 323. *Disease.*—Disease also has sometimes the effect of rendering the system tolerant of substances which in the same doses would, in a healthy state of the system, be poisonous. On the other hand, certain diseases render the body more susceptible to the influence of poisons. Examples of the fact first mentioned are seen in the tolerance of large doses of opium or other narcotics in tetanus, mania-a-potû, and some other diseases marked by great nervous tension. During the

active stage of severe inflammatory and febrile diseases, mercury may be given in large and repeated doses without producing salivation. Illustrations of the second are presented by the aggravation or the ready production of cerebral symptoms, after the use of small doses of narcotics, in those who have a predisposition to cerebral congestion or apoplexy, and by the extreme facility with which salivation follows the administration of mercury in persons affected with the disorganization of the kidney, which usually accompanies albuminous urine. The use of iodide of potassium after mercurial preparations, is said to favor the development of the mercurial cachexia.

§ 324. *Evidence of poisoning.*—The medical evidence in cases of suspected poisoning, is derived from several sources, to wit, *the symptoms, the post-mortem appearances, chemical analysis, and experiments on animals;* the whole evidence being at the same time strengthened by reference to the known effects of the poison in *other* well authenticated instances.

Certain poisons are more generally used than others, from the fact that they are better known on account of their use in medicine, or in the arts and manufactures. In France during twelve years (1851 to 1862), twenty-six substances(*a*) only have been employed, and of these the most common were arsenic, phosphorus, sulphate of copper, *verdigris*, sulphuric acid, and cantharides. Formerly arsenic was the substance most commonly employed, but of late phosphorus has taken the principal place. Suicide, however, has had recourse more especially to opium and its compounds.

§ 325. *Symptoms.*—It is but rarely that some knowledge of the symptoms preceding death is not obtained, even where the mode of their invasion has been unobserved. Occasionally, indeed, persons are found dead from the effects of poisoning, of the precise manner of whose death nothing can be learned, the suspicion of poisoning arising only in consequence of the finding of the phial from which the poison had been taken, or other circumstantial evidence of a similar character. Such are, in general, cases of self-destruction; the unfortunate victim

(*a*) Briand et Chaudé, Méd. Lég., 1869, 448.

of misfortune or excess having designedly withdrawn himself from observation, with the view of being undisturbed in his purpose. But in most cases of accidental and homicidal poisoning, some knowledge is acquired, either directly or indirectly, of the nature and progress of the symptoms. With few exceptions, medical aid is sought, and the direct testimony of the physician can thus be obtained.

The first condition of the intoxication (poisoning) is the absorption of a drug, and if this absorption does not occur, fortunately there are no poisonous effects to be noted; for example, the absorption of arsenious acid may be delayed or prevented by the ingestion of some albuminous substances, such as milk, thus locking up the poison in a coagulous mass, which cannot be received into the circulating system.

There are three different ways by which poisonous drugs may be introduced into the system. These are the mucous membranes, the skin, and the cellular tissue. Whatever may be the way by which the agent is introduced, science possesses the means of recognizing deleterious substances, whether in the blood, the secreted fluids, or in the tissues themselves.

§ 326. Whenever a man in apparently full health is suddenly overtaken with serious and increasingly alarming symptoms, accompanied with pains in the region of the stomach; or when, in the absence of vomiting and diarrhœa, a complete prostration of the vital forces, a cadaverous expression of countenance, and an abundant perspiration suddenly appear and are soon followed by death; there is good reason to suspect poisoning, the attestation of which must be proved by anatomical and chemical examination of the body.

The object of the medico-jurist here, as in all other attempts upon the health or life of an individual, is to determine in a precise manner the cause of the disease or death; but, in the majority of crimes, the expert who is called upon to investigate these causes may not begin his examination for weeks or months after the commission of the deed, and until suspicions have led to judicial interference; hence, the natural difficulties the expert would experience are greatly enhanced by the unnatural delay.

The expert has three sources of information for his guide:—
1st. As to the nature of the symptoms which have preceded the death.(*b*) The great difficulties connected with this source of information are: 1st. The unwillingness and ignorance of those who witnessed the symptoms; and the fact that a great number of poisons cause symptoms that are almost identical in character.

2d. The examination of the viscera at the autopsy. The pathological condition of these is not alone sufficient to establish a conviction, and a nice discrimination must be made between the effects of disease or a poison. The condition of these viscera can only establish a presumption, especially if

(*b*) In regard to the value of symptoms as an indication of poisoning Dr. Rees (Am. Journ. Med. Sci., April, 1872, p. 353) quotes from Christison: "It is now laid down by every esteemed author in medical jurisprudence, that the symptoms, however exquisitely developed, can never justify an opinion in favor of more than high probability." (Christison here refers to the work of Orfila, ii. 360.) "And again, p. 295, when treating of arsenic, 'the present doctrine of toxicologists and medical jurists seems universally to be, that symptoms alone can never supply decisive proof of its administration.' 'All these symptoms may be caused by natural disease,' * * * 'consequently, every sound medical jurist will join in condemning unreservedly the practice which prevailed last century, of deciding question of poisoning in such circumstances, from symptoms alone.'"

The first of the above quotations made by Dr. Rees in his review of Mrs. Wharton's case, will be found on the 37th page of the second Edinburgh edition of Christison's "Treatise on Poisons," and immediately after these words occurs the following sentence: "In laying down this doctrine medical jurists appear to me to have injudiciously confounded together actual symptoms with their general characteristics. If the doctrine is to be held as applying to the evidence from symptoms only so far as they are viewed in questions of general poisoning; that is, as applying to the general characteristics merely of the symptoms; it is deduced from accurate principles. But if it is likewise to be applied, as recent authors have done, to the actual symptoms produced by particular poisons, then it is a rule clearly liable to several important exceptions. These exceptions will be noticed under the heads of the mineral acids (p. 159), oxalic acid (p. 201), arsenic (p. 296), corrosive sublimate (p. 386)." Immediately following the second quotation will be found this sentence: "But modern authors appear to have overstepped the mark, when they hold that the rule against deciding from symptoms does not admit of any exceptions. For there are cases of poisoning with arsenic, not numerous certainly, yet not very uncommon either, which can hardly be confounded with natural disease; in which the power of deciding from symptoms alone is most required, because the chemical evidence is almost always wanting."

the autopsy is not made immediately after death. The natural decomposition of the tissues of the body may often mask the pathological condition of the viscera.

3d. The discovery and the demonstration of the poisonous agent. The intervention of chemistry, and perhaps of physiology(*c*) likewise, are necessary in this third source of information. If the poisonous agent can be isolated from the tissues of the body, and be determined to the satisfaction of twelve capable men, to be an active poison; if moreover the quantity of this agent discovered be sufficient to endanger the life of an individual; then, indeed, have the suspicions assumed an important position in the field of investigation: "Tunc demum res certa erit, ubi venenum ipsum reperietur facile agnoscendum." Still this third source of information must not be relied upon to the exclusion of the other two.

"Finally the last element to constitute poisoning is the finding in the body of the victim a substance capable of causing death. We shall see, soon, that this single determination cannot serve as perfect proof, since there would be reason enough to search whether or not the presence of the suspected substance could be explained by another cause than by poisoning. * * * Upon this point it should be remarked that chemistry can always extract from the body of a person who has died from poison, the poisonous substance which exists in the organs; this substance is not always in such a condition that it can be isolated, and yet its presence can be proved by its physical and chemical characteristics. In this case the physiological reaction of experimentation must be demanded; and this putting in evidence the poisonous properties of the substance obtained from the corpse will achieve the result of showing that it is really the true cause of violent death, and that this is the fact of poisoning."(*d*) There may be many causes, at the time of the analysis, for the appearance of a poisonous substance; and it is important before relying upon such presumption that recourse should be made to other evidence.

(*c*) The only reliable test of the presence of atropine is by its local action upon the pupil of an eye in a living animal.

(*d*) Tardieu, Sur l'empoisonnement. Paris, 1867, p. 118.

§ 327. There are other means than simply the assistance of a practising physician which are necessary in the establishment of evidence, as, for example, a well-educated and qualified chemist, as well as a practical physiologist, whose experience and observation of nature will lead to a more faithful comprehension of symptoms caused by poisonous agents, and perhaps to a determination of causes which might otherwise remain doubtful. It is all important that both the chemist and physiologist should be shown to be well acquainted with the details connected with their testimony. The assistance of the physician, the chemist, and the physiologist is indispensable, and, however distinct may be their part, it is right that they should bear a mutual support to each other. A practising physician's testimony may not be always as strong as that of a physiologist, whose duty it is to know the laws of life, and who must by direct experiment, observation, and sometimes with the use of poisonous agents, determine the causes of lesions of the organs of all portions of the body. The expert should be acquainted with the effects of different poisonous substances upon the living body. It is also important to seek for and to discover the poisonous agent, to indicate its nature, and to show that death was caused by its very presence in the body during life. These verifications once established, and a harmony between the lesions shown by the physician or physiologist, and the substance discovered by chemical analysis being settled, then and only then can the conclusion be reached that death was due to poison. But, though chemistry can always extract a poisonous substance from the body of a poisoned individual, provided it remains in the tissues of the body, and can also demonstrate its effects, yet it is often impossible and absurd to expect of an expert to so isolate the substance that the jurors can touch it, and by comparison with a similar substance feel certain that the two specimens are identical. This kind of proof may be demanded for such substances as arsenic, mercury, and copper; but how would it be possible to isolate from a mass of organs a ponderable amount of strychnine, digitaline, aconitine, atropine, and a host of similar alkaloids, so that a jury could determine the substance exposed to view in the

bottom of a test-tube, or on a bit of porcelain, to be identical with a crystallized alkaloid obtained from a druggist's shop? Appropriate chemical reactions and physiological experiments should demonstrate whether the substance produced in court is capable of acting as a poisonous agent, and furthermore proofs should be exacted of the presence of this very agent in some organ or tissues of the body of the victim.

§ 328. Generally, the action of one poison is different from that of another. 1st. Certain of these poisons act directly upon an organ with which they may be in contact, and from this we may be led to believe that their action is local. 2d. Others are immediately absorbed, without at first producing any direct effect, and, being carried through the economy by the circulatory system, produce their impression upon certain parts of the nervous system, and then react upon the other organs. Thus we are led to believe that their action is general. 3d. There is another set of poisons which act not only locally as above described, but also generally. Some of these act upon a special organ and in a particular way; for example, the tartar emetic determines an inflammation of the pulmonary and intestinal mucous membrane; corrosive sublimate irritates the valves and internal tissue of the heart; cantharides and squills act upon the urinary and genital organs, strychnine upon the spinal cord, etc. This is true of these drugs, no matter how they may be introduced into the system.

§ 329. All poisons act by absorption,(*e*) (though certain of

(*e*) On the trial of Elizabeth McCraney, at Otsego, New York, in December, 1860, for the poisoning of Huldah McCraney, the evidence was that the deceased, during her illness, exhibited, in the opinion of several experts, symptoms common to arsenical poisoning, and that arsenic was found in the remains. The case of the prosecution was that the arsenic had been administered by injection in the rectum. There was some conflict among the experts in their opinion as to the cause of death, and the defendant was acquitted. (People *v.* McCraney, 6 Harris C. R. 49, where the medical testimony is reported in full.) That poison may be administered by injection, and be detected by the tests heretofore announced, is well established. (Ibid. Taylor on Poisons, 2d Am. ed., pp. 111, 229, 373; Taylor's Med. Jur., 4th Am. ed., 68; Beck's Med. Jur., 11th ed. 447; London Lancet, Dec. 22, 1855; Med. Times and Gazette, Dec. 22, 1855; Edin. Med. Journ., Jan. and Feb. 1856, cited in 6 Parker's C. R. 110.)

them may cause local lesions by their irritant properties), and are carried by the blood through all the tissues. They are eliminated with the excretory fluids. On the ratio of elimination to absorption depends the activity of these poisons. If a drug is absorbed more rapidly than it is eliminated, we get symptoms of the action of this drug. Unless the inhalation of ether exceeds its exhalation, no etherization is produced. Unless prussic acid is absorbed more rapidly than it is eliminated, no poisonous symptom follows. In certain animals the elimination of a drug is so rapid that it is extremely difficult to cause death by the administration of this drug. Belladonna is eliminated very rapidly by goats, and it is almost impossible to destroy their life by this drug. The same is true of prussic acid given to horses, etc.

§ 330. (*a*) *The mode of invasion of the symptoms.*—In most cases of acute poisoning, by which is meant those in which a single dose capable of destroying life is taken, the symptoms arise more or less *suddenly*. In the chapters upon the individual poisons, the length of time elapsing before the accession of the symptoms, will be given; it varies with each poison, and is influenced also by several circumstances, such as the fulness or emptiness of the stomach, the state of health, and the habits of the individual. Although arising suddenly, the symptoms do not necessarily follow *immediately* the ingestion of the poison. If it have been swallowed in food or drink, the symptoms announcing the fact of poisoning may not come on for an hour or more afterwards. This fact has been frequently observed in arsenical poisoning, and is usual in poisoning by opium, belladonna, digitalis, and some other narcotics. But, when the symptoms have begun to manifest themselves, there is a progressive development of them, and they present (like any disease) certain features, which, combined, form a portrait by which they may be referred to some one class of the poisons, or be known to depend upon a particular poison. It is not, indeed, meant that there may not be a remission of the symptoms in poisoning, due either to the influence of treatment or to the spontaneous struggles of nature; but this circumstance, which is more apt to take place when a dose insufficient for the destruction of life has

been taken, can hardly affect the value of the sudden accession and development of characteristic symptoms. It should not be overlooked, that poisons have sometimes been taken or administered otherwise than by the mouth, as by the rectum or vagina, and in the case of volatile poisons, as carbonic acid, prussic acid, ether, chloroform, etc., by the lungs.

(*b*) The *duration of the symptoms* is another consideration, which has important bearings. Although sudden death is not produced by the majority of poisons, or at least by such as are usually swallowed, yet death from acute poisoning is an early result. A few minutes or hours may suffice; and, on the other hand, the patient may survive for days. No general rule upon this point can be laid down; arsenic usually destroys life within twenty-four, opium within twelve hours, and prussic acid in a few minutes. Exceptions are seen to all of these general rules; and with no poison is there so wide a range in the duration of the symptoms as in arsenic, since it has been known to prove fatal in less than two hours, and after several days. The reader will find sufficient details upon this point hereafter.

All the importance of the evidence derived from the symptoms depends upon the possibility of showing a distinction between them and a disease suddenly developed. This distinction should be sufficient, not merely to satisfy the mind of the physician, but to afford convincing proof to the jury upon the subsequent trial. This is often the most difficult and annoying duty of the physician; for while his own mind may be perfectly satisfied of the correctness of his judgment, he can rarely, with perfect conscientiousness, assert that the symptoms might not be explained upon the supposition of disease. Hence, this portion of the medical evidence cannot stand alone, but must be supported either by the positive correspondence with it of the post-mortem appearances and chemical analysis, or by the absence of any evidence from the autopsy confirming the notion of disease. Thus, in suspected poisoning by strychnia, the tetanic convulsions caused by this alkaloid might be readily and plausibly ascribed to other external or internal causes; upon the symptoms alone, it would be impossible to base evidence sufficiently strong to procure a

conviction. Or again, should a person die with the symptoms of irritant poisoning, the physician would find it difficult to defend the position that similar phenomena might not be witnessed in an attack of cholera, or in gastro-enteritis, arising from some other cause. Dr. Lee says: "During the prevalence of malignant cholera in 1832, we mistook a case of poisoning by arsenic for an attack of this disease. A lady took more than a drachm of the arsenite of potash, as we afterwards ascertained, with the intention of destroying her life, which was followed by severe retching, vomiting, cramps, livid, cold, and clammy skin, and the other symptoms which usually attend a severe attack of cholera."(*f*)

§ 331. *Chemical anaylsis.*—The indefatigable researches of Orfila in the domain of toxicology, and the assiduous culture of this science by other eminent chemists, have placed in our hands perhaps the least fallacious of all the means for verifying the fact of poisoning. It is of the utmost importance that the chemical analysis in cases of suspected poisoning should be intrusted to a competent chemist, capable not only of conducting it with system and accuracy, but also of meeting the numerous objections that may, at the subsequent trial, be brought against his evidence. In the majority of cases of poisoning chemical tests are applicable and yield a positive result; they may, except where the poison is of a volatile character, or is liable to destructive decomposition, be employed with the certainty of valuable results, at considerable periods after death. The substance or liquid submitted to analysis may be either a portion remaining unconsumed, or the food in which the poison has been taken; it may be the matters rejected from the stomach, or the secretions by which the poison is eliminated from the system; it may be the contents of the stomach as found after death; or, finally, the viscera themselves or the blood where it has arrived by absorption. The fallacies attending chemical analysis, when conducted by an expert chemist, are few; they arise chiefly from the fact of the possible accidental impregnation of the reagents or of the substance to be examined, with the same

(*f*) Copland's Dict., Am. ed., art. "Poisons."

mineral poison as that which it is the object of the analyst to detect, or its existence as a natural constituent of either. Other objections that may be raised are due to the faulty manner of conducting the investigation, or to an over-hasty inference from too limited a number of tests. In estimating the value of the chemical proof of poisoning, the quantity of the supposed poison is of essential importance. The question of the life or death of the accused person in trials for murder, or of his character under other circumstances, is too momentous a one to be determined upon any but the most positive proof. This, in the present instance, consists in the extraction from the dead body, or from the matters discharged during life, a substantial portion of the alleged poison, which can be recognized not only by its behavior with different reagents, but by its physical qualities, the form of its crystals, if any, its taste, smell, etc. Unless, moreover, this evidence points to the same cause of death as that which is indicated by the symptoms, it would be not only hazardous, but cruel, to conclude that a crime had been committed. Indeed, the only value of chemical analysis in judicial questions such as those referred to, is, when its results are positive, to corroborate the evidence derived from the symptoms during life. With regard to the possibility of poison being surreptitiously introduced into the stomach *after* death with a view of casting suspicion upon others, we may safely say that its consideration is not required until some authentic instance of the fact can be produced. This is one of the chimeras of medical jurisprudence, which the ingenuity of authors has evoked, but whose existence is fabulous if not absurd.

Differential diagnosis of poisoning.—The physician is often at a loss, upon the first view of a case of poisoning, to determine whether the symptoms presented by the patient may not be really due to disease. The aspect of a case of irritant poisoning presents a certain resemblance to cholera or to gastro-enteric disturbance, and most of the phenomena of narcotic poisoning are found in acute diseases, affecting the brain or spinal marrow. Should he content himself with remaining a silent spectator of the case, he may remain in doubt until its close; but if, on the contrary, he has witnessed or been

made aware of the time and circumstances under which the symptoms came on, and their mode of invasion, he will be less embarrassed, and, if an autopsy is obtained, can seldom be at a loss to give a decided opinion. The diagnosis must always remain incomplete without a *post-mortem* examination, whether its results be positive or negative; and hence, for practical ends, the careful analysis of symptoms in those diseases, which leave but few traces behind them, is of primary importance.

§ 332. The diseases most apt to be mistaken for *irritant* poisoning are:—

(*a*) *Cholera.*—This disease in its *malignant* form, as is well known, is often rapidly fatal; it may supervene shortly after a meal or a draught of liquid; its onset is sometimes sudden, although usually preceded by diarrhœa; there are great thirst, vomiting, and purging, without effort, of a thin and slightly turbid liquid; the surface is cold and shrivelled, the features collapsed, the voice almost extinct, the pulse feeble or imperceptible, and the intellect undisturbed; the lesions discovered after death are not sufficiently characteristic to be used in evidence, the most uniform, perhaps, being an increased development of the glands of Brunner in the small intestine. In most of the symptoms enumerated, it may resemble very closely a case of poisoning by arsenic or other irritant, but there are, nevertheless, sufficient means of distinction. In poisoning by the irritants, a burning sensation in the throat and stomach, and pain and distress in the whole abdomen, but chiefly over the stomach, precede, or are simultaneous in their occurrence with, the vomiting. They are the most prominent and constant symptoms during the continuance of the case. The matters passed from the stomach and bowels, after their previous contents have been evacuated, are mucous and bloody, and are not spouted forth as in cholera, but rejected with great distress and effort. The anus is often indeed excoriated by their irritating properties. Furthermore, it may be observed, that those who have once witnessed a case of malignant cholera will most probably have the peculiar but indescribable features of this disease so impressed upon their memory, that they will not readily mistake for it any case of irritant poisoning. Finally, the epidemic prevalence of the disease, or the

fact that about the same time other cases resembling Asiatic cholera have occurred, will materially assist the physician in giving a positive opinion as to the nature of the attack.

§ 333. (*b*) *Bilious cholera*, or *cholera morbus* as it is usually termed, is a disease which has more points of resemblance to the effects of poison than that which has just been mentioned. In it, both the extreme collapse and the peculiar rice-water discharges are not seen; but, on the other hand, the vomiting and purging are of a bilious character, and there is excessive pain in the abdomen. The progress of the case is, however, different. The pain in cholera morbus is remittent, coming on in paroxysms; and in proportion as the offending matters are discharged, the vomiting is less frequent and painful. In irritant poisoning, on the contrary, the pain is constant, and there is usually also tenderness upon pressure; the vomiting is of mucus and blood, and the discharges from the bowels are of a similar character. The tendency in the latter is to death, in the former to recovery. Cholera morbus is seldom fatal, and when it is, death does not in general take place for several days. The contrary is the rule in poisoning by the irritants. Such are the distinctions usually advanced by authors; and while they are, as a general rule, undoubtedly correct, it should not be forgotten that distinctions valid in medicine may not be so in their application to criminal cases. While, in the science of medicine, diagnosis is founded upon a careful investigation of the prevailing and general characters of diseases, the most delicate questions in medical jurisprudence are, on the other hand, determined by exceptional cases. Now, as experience shows that persons may not die from the effect of the poisonous irritants until several days have elapsed, or, indeed, that they may not die at all, we are at a loss to perceive how, in such cases, it will be possible, in the absence of circumstantial and moral evidence, to decide that the symptoms were due to attempted poisoning, rather than to the disease in question; for, although there may be some points of distinction, as, for example, the early occurrence of a burning sensation in the throat, the unremitting character of the pain, and the sanguinolent discharges, yet these may be absent in mild cases of poisoning, and where life is not destroyed. On the

whole, we consider the assertion hazardous and untrue, that in every case the symptoms of irritant poisoning can be distinguished from those of bilious cholera.

The corrosive poisons leave traces behind them sufficiently distinct to prevent any likelihood of mistaking their effects for those of disease.

There are certain diseases or sudden accidents partially resembling in their symptoms those of the irritant poisons, which are so readily recognized on post-mortem examination, that it is needless to enlarge upon the modes of distinguishing them. These are rupture of the stomach, intestine, biliary ducts, and uterus, and no one will contend that such lesions can be produced by poisoning.

§ 334. (*c*) *Perforation of the stomach* may, however, give rise to embarrassment; not, indeed, so much from the symptoms of the disease when considered alone, but from their offering perhaps sufficient resemblance to those of poisoning to support the opinion that the lesion referred to may be due to this cause. While it is true that in this disease, the seizure is sudden and the pain in the abdomen acute, it is not preceded by the sensation of burning in the throat and stomach, nor is the vomiting urgent unless upon the ingestion of the liquids. There is again no diarrhœa; the main symptoms are acute diffused pain all over the abdomen, arising from peritonitis, and the patient is collapsed from the first. But in a case of this kind, which has not been closely observed, the discovery after death of the perforation in the stomach will naturally awaken the suspicion of poisoning. If we now inquire under what circumstances this lesion is produced in cases of poisoning, we will find that with the exception of the corrosive acids it is seldom occasioned by any kind of poison. Perforation from arsenic, which poison is the one to which it will most probably be attributed, is so rare an event that but three cases are said to be on record, and the fact of the perforation being so unusual in a form of poisoning so exceedingly common, renders it highly probable that in these instances it was due to an already diseased state of the coats of the stomach. But the corrosive poisons, which undoubtedly produce, in many instances, a perforation of the stomach, leave in addition such

manifest traces of their action upon the throat, œsophagus, and stomach, not to mention the corrosion of the mouth and lips, that it seems to be inexplicable how the single fact of the perforation should leave any doubt in the mind of the examiner or of the jury. Moreover, the character of the perforation alone affords a sufficient ground of distinction. The stomach in such cases is blackened and extensively destroyed; the aperture is large, its edges rough and irregular, and the coats are easily lacerated. Further, the poison escapes into the cavity of the abdomen, where it may be easily discovered by chemical analysis. In perforation from disease, on the other hand, if the affection be of a cancerous nature, there will be no difficulty in distinguishing the cause, and, if it be simple ulceration, such as occurs sometimes in persons in the enjoyment of apparently good health, the opening is also characteristic in its nature. "The aperture is usually of an oval or rounded form, about half an inch in diameter, situated in or near the lesser curvature of the stomach, and the edges are smooth. Indeed it has not unfrequently the appearance of having been 'punched out.' The outer margin of the aperture is often blackened, and the aperture itself is funnel-shaped from within outwards—*i. e.*, the mucous coat is the most removed, and the outer or peritoneal coat the least. The coats of the stomach, round the edge of the aperture, are usually thickened for some distance; and when cut they have almost a cartilaginous hardness." (Taylor.) Death takes place from peritonitis, the contents of the stomach being effused into the cavity of the abdomen.

§ 335. There is still another form of perforation, which is due to a solution of the coats of the stomach by its contents after death. It cannot give rise to a suspicion of poisoning, unless in the absence of any knowledge of the symptoms preceding death. It is purely a cadaveric phenomenon, and may occur in the stomach of persons dying from any cause, provided the peculiar fermentative process necessary for its production exist.(*g*) It is formed only in the larger end of the stomach,

(*g*) See Med. Times and Gaz. (No. 246, p. 268), for a case in which the stomach of a child (which had been asphyxiated by its intoxicated mother

ening is large and irregular, with ragged and pulpy and no surrounding inflammation. The edges may be ored and black, as the result of a chemical action of the nal gases upon the coloring matter of the blood. There peritoneal inflammation, but the spleen, diaphragm, or subjacent viscus may be softened by the acid. The ab- of any disorganization of the pharynx and œsophagus, peritoneal inflammation, is sufficient to distinguish this ortem perforation from that caused by corrosive poison, which alone it is possible to confound it. Dr. Budd has naturally enough, that this post-mortem softening of ats of the stomach is more common in hot weather. He "During the past summer, which was a very hot one, tention was casually drawn to this subject, and from the e of May to the middle of August, I carefully examined mach in all the bodies that were opened in the King's e Hospital. In several instances the mucous membrane stomach, in the greater curvature, was completely yed, and in a very large proportion, it had been clearly upon more or less by the gastric juice. I renewed my ations in October, but the change, in a striking degree at was then much less frequent."(*h*)

uld the rules thus laid down for the discrimination of urce of these perforations not prove sufficient, a resort mical analysis will render the demonstration complete. poison has been taken in so large a dose, or is possessed h violent properties as to cause the lesion thus referred will readily be found by these means. It has been said person may die with the symptoms of irritant poisoning, ter death, perforation, the result of cadaveric change, be and that hence the knowledge of the true cause of the

it too closely) presented the following appearances: Nearly the f the great *cul de sac* had disappeared; the edges of the aperture in, jagged, and flocculent; another similar but smaller opening lower down and abutted upon a corresponding aperture in the trans- lon. No unnatural adhesions or other morbid appearances existed, uantity of milk was found in the stomach and in the cavity of the n.

ancet, 1847, p. 593.

perforation does not exclude the idea of poisoning. It is true that such a rare coincidence may happen, but the want of connection between the poison and the perforation merely renders it necessary to support the charge upon other evidence. The case of Miss Burns, for the murder of whom, by poison, a Mr. Angus, of Liverpool, was tried in 1808, is one in which this doubt arose. The charge of poisoning was not sustained by chemical or pathological evidence, and the prisoner was acquitted.

§ 336. *Perforation of the intestines* is also occasionally met with, but as it is not the result of poisoning, except in circumstances where this can be readily known, it is unnecessary to dwell upon it.

§ 337. (*d*) *Gastritis, gastro-enteritis, peritonitis.*—It is the natural effect of poisonous irritants to produce one or more of these diseases, but as they may arise from other causes, a distinction is in practice necessary. Gastritis is rarely, if ever, primary or idiopathic, and with the other two affections has a more protracted course than is usual in irritant poisoning. Diarrhœa, so universal a symptom of irritant poisoning, is not always present in these diseases, and there is in them an intense febrile condition which is not seen in poisoning. However satisfactory these distinctions may be to a physician, it is apparent that they may have little weight with others; hence, practically, it is important to examine them closely, for the accusation in such cases will have to depend upon the results of the chemical investigation.

(*e*) *Strangulation of the intestines* has been enumerated among the diseases likely to awaken suspicion of poisoning, but with little justice, for if the symptoms are not sufficient to distinguish it, most certainly it cannot fail to be detected upon the post-mortem examination.

§ 338. The symptoms produced by *narcotic poisoning* may be closely imitated by those of natural diseases, such as apoplexy, epilepsy, congestion of the brain, and tetanus. Indeed, occasionally the similarity is so great, that, upon the medical evidence alone it may be impossible to acquire a certainty of the cause of death. Many distinctions have been drawn by writers upon toxicology, between the effects of narcotic

s and those of disease of the brain and spinal marrow, ey serve only to show the very close analogy between When, moreover, it is remembered that the most im- t of these poisonous agents leave no distinct traces in ad body of their action, it will be perceived that the ntial diagnosis must depend mainly upon the results of al investigation, and the moral or circumstantial evi- in the case.

Apoplexy, it is said, may be distinguished from opium ing by the following considerations, viz: that it does ually occur under the age of thirty, nor come on with- rning symptoms, and that the time of seizure is irre- e of the taking of food or drink; but these distinc- re futile, even when, as is rarely the case, an accurate t of the whole history of the sickness can be obtained. reliable are the facts that in poisoning by opium the ms are gradual in their accession, and that the more ed effects are preceded by drowsiness, and that the pa- ntil an advanced period of the stupor, can be tempo- roused from it. The pupils also, in general, are strongly ted, and there is no contortion of the face or paralysis limbs. In the majority of fatal cases of apoplexy, the is sudden, although indistinct warning symptoms may receded it; the patient cannot be roused, the pupils are and insensible, and the face is slightly contorted, indi- a paralytic condition of one side of the body. Yet, let en to say, there are numerous exceptions to these rules, which is easily understood, when we reflect that opium tion to its specific narcotic properties produces the very athological condition, with the exception of effusion of nto the substance of the brain, from which it is our distinguish it.

Cerebro-spinal meningitis.—This disease has been con- d with poisoning by tartar emetic in the trial of Mrs. Wharton, at Annapolis, Maryland, in January, 1872. at attempting either a review of that case,(*i*) or a gh description of the above disease, it may be advisable

(*i*) Amer. Journ. of the Med. Sciences, April, 1872, p. 329 *et seq.*

to relate the character of the symptoms most usuall
in this serious epidemic disease. Dr. Ed. Warren, in t
alluded to, stated that the patients are in a "con
semi-unconsciousness and of increased sensitivene
surface of the body, so that they shiver when touc
have a rigidity of the muscles of the neck, back, an
extremities; pupils neither contracted nor dilated,
sitive to light; suppression and retention of urine
of countenance; trismus; opisthotonos; occasional j
and restlessness; incoherent articulation, and a sp
violent death."

This disease occurs most generally as an epiden
more frequent in winter and spring than in the summ
The best authorities (Niemeyer, Aitken, Valleix, an
country, J. B. Upham, A. Stillé, W. H. Draper, S. A
others) describe the disease as commencing, often
or no positive warning,(*k*) with a severe chill of va
ration, accompanied by a severe headache, and in
by vomiting. At the end of the first or second d
later, the head is drawn backward. The severe head
tinues, the pain extending down to the nape of the
along the spine. The third or fourth day the mus
traction, especially in the vicinity of the neck and
quite remarkable, and to this succeeds opisthoton
arching of the back in such a way that the body
only upon the heels and back of the head); conscio
lost; constipation, rarely diarrhœa, continues throug
whole progress of the disease; the pulse is not gener
rapid than in health, though it may be irregular
towards the close of the disease, if fatal, the pulse
rapid. The urine is suppressed or retained. The p
of the respiration is a marked feature of the disease.

The post-mortem appearances of this disease are mor
if the disease has existed several days before death

(*j*) Reported and published by the Baltimore Gazette, p. 97.

(*k*) A police officer at Dublin, Ireland, was stricken down sudd
on his beat, became unconscious, then had violent convulsions, an
in less than ten hours; though he had the same morning left his
parently in good health.

t dies during the first stage, viz. before exudation occurs, pearance of the brain and spinal cord is not peculiar, tentimes no great change in any organ has been remarked. ally the appearance, as described by Niemeyer, in recent is as follows: "The subjects show no emaciation, pro- d rigor mortis, or extensive hypostasis. The cranium ins much blood; the dura mater is more or less dense and onally covered with small hemorrhagic spots. There is ly no effusion between the outer membranes; in the sub- noid space there is an exudation, which, both in extent haracter, occupies about a medium position between the ent exudation in meningitis of the convexity and the serous exudation in meningitis of the base of the brain." rain itself is more or less vascular. The dura mater of ine is also more or less vascular, occasionally very tense, ially at the lower part. The arachnoid usually presents culiarity except a decided opacity. The spinal medulla is more or less vascular, occasionally infiltrated and re- . Except some accidental complications there are no ular anomalies of the other organs; we should especially here that the spleen is almost always normal.

Tetanus.—The same remark is applicable to the resem- e between the convulsions of *tetanus* and those produced rychnia. It is needless, therefore, for us to draw a parallel een the diseases referred to and the symptoms so closely ating them, produced by the poisonous narcotics. Where success of either prosecution or defence comes to stand such vacillating ground as this, other sources of evidence ng, it would be better that the most approved works on ology should be consulted and the descriptions of disease e given be compared with the symptoms enumerated under narcotic poisons, than that the reader should draw an un- anted conclusion from such an imperfect abstract as it ld be proper for us to give in this place.

Palmer's case, the distinction between the symptoms of oning by strychnia, and tetanus, was thoroughly inves- ted.(*l*)

(*l*) Lond. Lancet, May and June, 1856.

must at once negative the presumption of poiso
taken. Thus, certain diseases of the heart, ove
the stomach, fatal syncope, and some obscure dis
be recognized at the autopsy, but the mode of
is entirely different from that in any form of
cept, perhaps, by prussic acid, in which the odo
tests will disclose the cause of death. The in
careful collection and comparison of *all* the me
in every case, cannot be too strongly insisted u
this combination of proof it is that a correct kn
true cause of death must depend.

§ 340. *Sources of error arising from natural*
body after death.—Having thus shown the chief
tinction between the effects of poison and of th
eases to which the human frame is subject, it on
us to point out some sources of error which the n
taking place in the body *after* death may give
important subject is one which has received but li
at the hands of medical jurists, but there can be
the *natural* appearances of those parts of the bo
spected after death, where poisoning has been at
alleged, are often mistaken for pathological ch
by the administration of poison. Nothing is m
than to meet with the expressions that "the sto
testines were red and inflamed," "the mucous coa
"the brain was highly congested," "the blood of
and fluid," etc.—statements which are objection
on account of their want of precision, but beca

of disease, because it is not inconsistent with a previous state of perfect health.

2d. That the effects of putrefaction and spontaneous changes, induced by the loss of vitality, are sometimes attributed to the actions of poisons.

3d. That the vascularity in question is entirely venous—the florid state of the vessels arising from the arterial character of the blood remaining for some time in the veins after its transmission from the arterial capillaries at the close of life; the appearance, however, is sometimes due to transudation only.

4th. That the fact of inflammation having existed previously to death cannot be inferred merely from the aspect of vessels in a dead part—there must, at least, have been symptoms during life.(*m*)

In the examination of the *stomach* it will be found that it presents variable appearances, according as it is inspected during or after the process of digestion, or after long fasting; whether it is empty or full, distended or contracted; and whether the distension is due to liquid or to air.

During, and immediately after *digestion*, the stomach is filled with gas and the remains of the food, and is, therefore, moderately distended, and its mucous membrane appears thin and does not lie in folds. Its color is of a pale rose, uniformly spread over the surface, or, if the organ is unusually distended, it is gray or dirty white. On the other hand, in the *fasting* condition it is strongly contracted, and the mucous membrane is corrugated and thick. Its color is of an ashen-gray when it is covered with mucus, but, when this is not the case, it is of a reddish-brown. It may be partly contracted and partly distended, in which event, the differences referred to will be visible at the same time in the pyloric and cardiac portion. Moreover, the cadaveric hypostasis, or settling of blood, will be seen on the folds of the mucous membrane, or in those portions of the organ which are the least distended. After the process of digestion is entirely completed, the abdominal system of veins is loaded with blood, and the same engorgement occurs in certain diseases of the heart and lungs; should death take place at such a time,

(*m*) Med. Gaz., vol. xvii. p. 309.

the mucous membrane of the stomach is found highly injected, and, in consequence of the transudation of liquids taking place in the dead body, ecchymoses are formed which often have the appearance of submucous extravasations; they frequently occupy the entire half of the stomach and both curvatures, and have a bluish-slate color. This injection may also occur in streaks, and thus give rise to an unfounded opinion that death was due to some irritant. This is especially the case where powdered substances, such as arsenic, are found near them, but it is a mere coincidence, since the existence of folds or rugæ is a sufficient explanation of the adhesion of the powder to these places.(*n*)

The softening of the mucous coat after death is of course seen in lesser degrees, and most probably is purely a cadaveric change depending upon the solvent powers of the liquids contained in the organ. When the mucous coat is found apparently thickened, this condition is often due merely to the stomach being in a contracted state; and, on the other hand, it may appear to be very thin when the appearance is wholly due to its distension. Similar sources of error to those we have thus cursorily noticed arise in the inspection of the brain, heart, and other organs. The physician should be upon his guard against them, and carefully distinguish the changes produced by disease from those which are brought about in the act of dying, or after death, by the position of the body and the transudation of liquids. If familiarity with the ordinary post-mortem appearances does not enable him to form a positive opinion as to the causes of death, it is far better that he should have the candor to say so, than, by giving an unwarranted opinion, incur the risk of causing the innocent to suffer. But in every case it is proper that precise and accurate language should be used in the description of post-mortem appearances, and that such expressions as inflammation, gangrene, etc., which imply the manner in which the morbid change has resulted, should not be used, but rather instead, such terms as will simply express the *physical* condi-

(*n*) Darstellung der Leichenerscheinungen, etc., von Dr. Josef Ha[illegible] Professor an der Universität zu Prag. Wien, 1854, 8vo.

tion of the part, in reference to its size, color, consistence, etc.

§ 341. From the foregoing remarks it is, we think, apparent that the most perfect evidence of poisoning is derived from the combined results of the investigation of the symptoms, post-mortem appearances, and chemical proof; should any portion of this evidence be wanting, the effect is thereby weakened, but not necessarily always to an equal degree; since a chemical analysis affording positive results, or a decided and characteristic post-mortem change, or a well-marked set of symptoms, may each in certain cases afford high probability, if not conclusive demonstration, of the fact of poisoning. On the other hand, the failure of the chemist to discover poison in the dead body does not always destroy the value of other evidence sustaining the fact of its having been taken, since the whole of it may have been removed by vomiting and purging, or if the patient have lived long enough, been absorbed into the system, and then eliminated from it principally by the urine. Indeed, in the case of the vegetable poisons, the chemical analysis is often fruitless, they having been rapidly volatilized, decomposed, or absorbed; but here, on the other hand, the symptoms are less likely to be taken for the effects of disease, or, if they are, the fallacy of the assumption is demonstrated by the autopsy.

§ 343. *Classification of poisons.*—We have followed in this treatise the classification usually adopted, viz., into IRRITANT, NARCOTIC, and NARCOTICO-IRRITANT poisons.(o) This division cannot be rigorously maintained except for the end of convenient reference; since there are poisons usually classed under irritants, which are likewise sometimes narcotic in their action, as, for example, arsenic and oxalic acid; and, on the other hand, some of the pure narcotics, especially opium, occasionally produce the symptoms of irritant poisoning. The classification is, however, sanctioned by the use of the most eminent

(o) Though this is certainly an unscientific and incorrect classification, yet, since it has become so familiar to American medical jurists, we have not thought it worth while to adopt the more scientific classification recommended in the "Memoranda of Poisons," by the late Thomas H. Tanner, third edition. London: Renshaw, 1872.

toxicologists, and, in the present imperfect state of our knowledge of the mode of action of poisons, has fewer objections against it than can be urged against any other.

The symptoms produced by each class of poisons are sufficiently indicated by their name. Thus, the irritants produce vomiting and purging, intense abdominal pain, and fatal exhaustion. Septic irritants produce, in addition, symptoms which are known as typhoid; and certain metallic irritants in small and long-continued doses give rise to impaired digestion and nutrition, and death by a gradual exhaustion of the system. Their primary action is expended upon the intestinal tube, causing inflammation or corrosion, and the effect upon the nervous system is secondary. The narcotics produce fulness of the head, vertigo, dimness of vision, delirium, coma, paralysis, and sometimes tetanic convulsions. The narcotico-acrid poisons produce stupor or delirium and convulsions, and also irritate the stomach and bowels, causing vomiting and purging. Both these and the irritant poisons are commonly known by their taste, which is hot and acrid, metallic, nauseous, or bitter; arsenic is the chief exception to this rule, as its taste may be either unperceived or be only distinguished as rough or sweetish. The corrosive poisons, such as the mineral acids and caustics, have so violent an effect upon the mouth and throat, that the mere fact of their having been taken affords a good presumption, in this country at least (from the readiness with which any kind of poison can be obtained), against their having been voluntarily swallowed. The pure narcotics have only a slightly disagreeable taste. This class is, however, but a small one compared with the others, and, with the exception of opium, rarely gives rise to judicial investigations.

§ 344. *Poisons considered under the head of symptoms and lesions which they determine. Classification of M. Tardieu*(p)— 1st. Irritants and corrosives; 2d. Hyposthenisants; 3d. Stupefiants; 4th. Narcotics; 5th. Neurotics.

1st. Poisoning by irritant or corrosive poisons has the peculiarity attributed to the local irritant action, which may result

(p) Etude médico-legale et clinique sur l'Empoisonnement, Paris, 1867.

)lent inflammation, corrosion, and a disorganization of issues attacked by the poisonous substance, the effects substance which has been swallowed being almost ex- ly due to lesions of the digestive organs.

The hyposthenisants have the peculiarity not merely of ing a local irritation, though this may actually occur, o causing general disturbances resulting from their ab- n; these latter may be disproportionate to the local which oftentimes are entirely absent, and are very it from irritation or inflammation; these consist in fact pid and profound depression of the vital forces, and are ted with a manifest alteration of the blood.

Poisoning by stupefying poisons, of which the largest i have been comprised under the improper denomination cotico-acrid, though producing neither narcotism nor y, has, as its essential character, a direct special action ie nervous system, a depressant action which corresponds it is called in *semiotics* (symptoms of disease) stupor, mes accompanied with a local irritation, oftentimes of t character.

Poisoning by *narcotics* is characterized by an action pecial and distinct, that can only be defined by its own *narcotism*.

Finally, poisoning by neurosthenic or neurotic poisons acterized by a violent excitement of the nervous centres, ensity of which may be so great as to produce death.

CHAPTER II.

IRRITANT POISONS.

oisoning by sulphuric acid, symptoms, § 345.
Ink, § 350.
Chemical examination for, § 351.
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Experiments on animals, § 369.
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I. *Sulphuric Acid.* (Oil of Vitriol.)

§ 345. CONCENTRATED sulphuric acid is a dense, oily, transparent and colorless liquid, with an energetic attraction for water. When diluted with water, heat is evolved by the mixture. It rapidly destroys and carbonizes organic matter, the extent of the destruction depending, of course, upon the degree of concentration of the acid, and the length of time it remains in contact with the organic structure. It is more frequently taken and given by mistake than by design, at least in our country, although cases are not wanting, in which it has been criminally given to young children. An interesting case is related in Henke's Zeitschrift, where it was used with the hope of inducing abortion. From the ease with which it can be procured, without awakening suspicion, it is sometimes made the means of self-destruction, and of late years, in England, numerous cases have occurred where it has been employed for the purpose of disfiguring the person, by being clandestinely thrown upon the face or neck.

§ 346. 1st. The *symptoms* which follow the ingestion of this acid depend for their intensity upon its degree of concentration, and the quantity taken. When the strong acid has been taken, violent symptoms at once arise. The lining membrane of the mouth, throat, œsophagus, and stomach, being instantaneously corroded by it, extreme agony is felt in these parts, violent efforts to vomit are made, dark and bloody masses of mucus are detached, and altered membrane may be discharged.(*q*) Death takes place in extreme suffering, generally

(*q*) When the dose of acid has not been sufficient to produce immediate perforation of the stomach, there may be obstinate vomiting, and the vomited

within twenty-four hours. In a case observed by Mr. Traill, death occurred in one hour, and in another related by Casper, where an adult took by mistake a mouthful of crude sulphuric acid, death took place in two hours. In most instances it will be found that the early administration of antidotes has mitigated the symptoms and prolonged existence for a short time. The last-named author mentions the case of a child, only seven weeks old, which lived eight days after it had been given concentrated sulphuric acid by its mother. Here the child was made to take carbonate of magnesia shortly after the poison had been administered.

When the diluted acid has been taken, the symptoms are less violent and the case is more protracted. The presence of food in the stomach has an important influence upon the fatality of the dose, since much of the corrosive or carbonizing action of the acid may be expended upon this, and the mucous membrane of the stomach be thereby shielded. Cases are recorded in which persons have survived for a long time. Thus, a young woman is referred to by Mayo, who lived eleven months after swallowing a tablespoonful of sulphuric acid, and then died from marasmus, in consequence of imperfect nutrition.

§ 347. 2d. The smallest *quantity* which has been taken with rapidly fatal results appears to be that which was given in a case quoted by Dr. Taylor. In it, the quantity is said not to have exceeded forty drops. But the patient was a child only a year old, and antidotes were administered about half an hour after it had taken the acid. The symptoms, however, came on immediately, and the child died in twenty-four hours. Dr. Christison says, that one drachm proved fatal to a young man in seven days. It is always difficult, however, to ascertain the exact quantity which has been swallowed, since the immediate impression made upon the mouth by the contact of so corrosive a liquid naturally excites an instantaneous effort to get rid of it. The amount actually swallowed forms usually, therefore, but a small portion of what is taken into the mouth.

matters may effervesce upon the ground, brick, or tile floor, or on any other calcareous substance.

It may, indeed, not reach the stomach at all, its action being expended upon the throat and œsophagus, and proving fatal by the inflammation and disorganization there produced.(r) Occasionally, also, it enters the air-passages. A case of recovery after an injection of sulphuric acid, given in mistake for castor oil, is reported.(s)

§ 348. 3d. *Post-mortem appearances.*—The following case will illustrate the effects of this poison when concentrated and swallowed. A man, thirty years of age, went to his closet in the dark, and drank a "good mouthful" of commercial sulphuric acid. He was bled shortly after, and the blood is described as being of a syrupy consistence. Milk and soapsuds were given to him, and brought on vomiting, but he died in two hours. The whole tongue was white and sphacelated, and the mucous membrane here and there detached. The fauces and œsophagus were of a grayish-black color; the stomach was perfectly black on both surfaces, and of a soft and pulpy consistence. The omentum majus was likewise partly carbonized, in consequence of the escape of the acid into the abdominal cavity. The upper portion of the small intestine was of a blackish color, and the mucous membrane swollen and indurated. The contents of the stomach yielded, on chemical examination, one drachm and seventeen and a quarter grains of free sulphuric acid.(t) In Mr. Traill's case, a washerwoman took a wineglassful of crude commercial acid of the specific gravity of 1.833, in mistake for ale. Although the proper antidotes were very soon administered, she died in one hour. A hole with ragged edges was found at the fundus of the stomach, and the adjacent tissue tore with the slightest touch. The rest of the mucous membrane was mottled with dark-brown patches. There was also great inflammation of the peritoneum, from the escape of the acid.(u) When much acid has been swallowed, the stomach presents an appearance which is altogether peculiar and characteristic. It is as black

(r) This happened in a case reported by Dr. W. Hull, in the Lond. Med. Gaz., June, 1850.

(s) Ed. Month. Journ., April, 1850.

(t) Casper Gericht. Leichenöff. 1 II. p. 117.

(u) Month. Journ., Aug. 1854.

coal, and its tissue is softened to a jelly. The acid, softening the walls of the bloodvessels, allows their contents to escape, and then, acting upon the blood, gives it a dark color. That such is the source of the black color referred to is proved by the fact that it is not produced when sulphuric acid is introduced into a dead stomach.(*v*)

In general, the eroded and inflamed appearance of the mouth and throat is found to coexist with the blackened and disorganized condition of the stomach. But sometimes the poison does not reach the stomach, and, when this is the case in young children, death may take place from the local action on the fauces alone. In Dr. Hill's case, already referred to, it reached the lungs. The epiglottis was partially destroyed, the vocal cords and the mucous membrane of the trachea were softened, the left pleura was perforated, and a crust of sulphate of lime formed upon the ribs. There was no trace of the acid, either in the œsophagus or stomach. The person was an adult female. It is probable, in such cases, that death takes place by suffocation, the glottis being closed by the tumefaction of the mucous membrane. Husemann reports two fatal cases in children of five years of age. The symptoms were chiefly those of inflammation of the throat and larynx, without any evidence of disorder of the stomach.(*w*) No dissection was made. In most cases of poisoning with sulphuric acid, there are also traces of its action left upon the skin, near the mouth, either from a portion escaping when swallowed, or from the corrosion of the vomited liquids. The marks thus left upon the skin are of a dark brown color, and of a leathery consistence. Where, however, the acid has been given in a spoon, the anterior portion of the mouth may escape entirely. In a case referred to by Dr. Taylor, the fauces,

(*v*) Orfila has established the fact that this acid even when it was taken in a concentrated form, can be absorbed after it has been diluted in the stomach and intestinal canal, and united with liquids therein contained, or which had afterwards been swallowed; and that consequently in autopsies all the viscera and the urine should be examined for the presence of this acid, even though nothing was found either in the alimentary canal, vomited matters, or the feces.

(*w*) Journ. f. Pharmakodyn. ii. 166.

œsophagus, and stomach of an infant ten days old, were much corroded by sulphuric acid, but there was no appearance of injury to the mouth. This was probably owing to a spoon having been used, and the poison having been poured down the throat slowly, as the mucous membrane was extensively corroded at the back part. A case is reported, in which although the acid was taken from a teacup to the amount of fifteen and a half drachms, there was not the slightest vestige of a stain on the outside of the lips, angles of the mouth, cheeks, neck, or hands, nor upon the clothing.(*x*)

There is a case on record(*y*) where a woman swallowed from a cup about a tablespoonful of strong sulphuric acid; the usual symptoms appeared, and she died in two days. The mucous membrane of the cheeks, gums, and tongue was not excoriated at any part.

On the other hand, a case(*z*) occurred in France, in which although no corrosion, nor any indication of the use of an acid, was seen in the mouth, fauces, œsophagus, or stomach, and the appearances in the last organ were not very striking, yet several eminent men, among whom were Devergie, Barse, and Lesueur gave their opinion that death was caused by sulphuric acid, and that the absence of the poison might be attributed to vomiting and its elimination with the urine. No trace of this acid was discovered in the viscera, and the only ground for the opinion seems to have been the presence of stains of sulphuric acid upon the clothing of the child, and a slight pathological alteration in the stomach. In children, especially, such an opinion can hardly be justifiable on such slender grounds.

We find a case of gelatiniform softening of the stomach, with perforation of the fundus, and effusion of a brownish liquid into the peritoneal cavity, reported by Dr. Casper. In this case there had existed suspicion of poisoning, which his opinion of the result of the examination set at rest; and it is by no means impossible that the preceding case may have been

(*x*) Dr. Walker, Ed. Month. Journ., June, 1850.
(*y*) Dr. Chowne, Lancet, July 10th, 1847, p. 36.
(*z*) Journ. de Chimie Medicale, 1846, ii. 17.

a similar one. Were it admitted, in the absence of direct proof by chemical analysis of the contents of the stomach, that an inflammatory condition, a softening, or ulceration of the stomach could be regarded, apart from any corrosion of the mouth or fauces, as presumptive evidence of poisoning, we should be led undoubtedly into many grave mistakes.(a) Spontaneous softening of the stomach in infants, and ulceration and perforation of this organ in adults, are not rare events, but their characters are far different from the charring and disorganization produced by sulphuric acid. We think that in no case is an opinion warranted that sulphuric acid has been swallowed, unless it can be clearly traced by its effects from the mouth or fauces to the stomach.

It has already been mentioned that in a case of poisoning by this acid the blood had a syrupy consistence. This condition is stated by Casper to be the ordinary one. He adds that the blood is generally of a cherry-red color, and that it has an acid reaction. This acidity has also been noticed in a pericardial effusion, and in the amniotic liquid of a pregnant female poisoned by sulphuric acid. It would appear that after death by this poison bodies remain fresh and without smell for an unusually long time; a fact which Casper explains by stating that the acid continues, until exhausted, to neutralize the ammonia which is given off in decomposition.

§ 349. This acid has been given by mistake in enema, and in one case death was produced thereby. It has also been thrown into the vagina, with the view of procuring abortion. In cases such as these the black and disorganized appearance of the parts, and the evidence of the presence of the acid on chemical analysis, will form the grounds of an opinion as to the cause of death.

§ 350. 4th. *Poisoning by ink.*—A drunken soldier had given to him a large glass of ink, under the pretence that it was porter. He drank it, and, after sleeping for an hour, awoke in the most violent pain. He suffered extreme weakness, headache, and painful cramps in the thighs. After four or five hours he commenced vomiting a pasty mass mixed with

(a) See *ante*, §§ 334, 335.

ink, which gave strong indications of sulphuric acid. Mucilaginous and saccharine beverages were given him, and after a short time he improved. He was convalescent on the third day, but still complained of weakness, trembling, and an oppressive pain in the back of the head.(*b*) Ink, we may observe, does not usually contain this acid, and the liquid employed may not have been ink, but blacking, of which sulphuric acid is an ingredient.

§ 351. 5th. *Chemical examination.*—Concentrated sulphuric acid is known by its oleaginous appearance, great specific gravity, its property of setting free the carbon of organic substances (thus charring them), and by the evolution of heat on its being mixed with water. When *diluted*, the best evidence of its presence is obtained by the addition of any of the soluble salts of baryta, the sulphate of baryta being immediately precipitated in the form of a heavy white powder. The precipitate is insoluble in nitric and hydrochloric acids. Further proof of its presence may be obtained by igniting the precipitate with carbonate of soda or with vegetable charcoal, by which the sulphate is reduced to a sulphuret, which may be shown by its blackening a bright silver surface on being moistened with water. In testing a solution for sulphuric acid by means of a salt of baryta, care should be taken that the liquid does not contain too much nitric or hydrochloric acid, as salts of baryta, which readily dissolve in water, are almost insoluble in these acids. The liquid containing the precipitate may be diluted with distilled water, which will redissolve all the other salts but the sulphate. In order to ascertain whether the sulphuric acid exists in a free state, a portion of the liquid may be evaporated to dryness, when, if uncombined sulphuric acid be present, it will be entirely driven off in dense white fumes.

§ 352. When the liquid to be examined is mixed with *organic matters*, it must be filtered; or, if turbid and thick, it should be first boiled with distilled water, and then filtered, before the tests, as above, are applied. In most cases of

(*b*) Am. Journ. Med. Sci., April, 1854, from Pharmaceutical Journal, Oct. 1853.

poisoning by this agent, antidotes have been used, which may have completely neutralized the acid. Hence, although it may not be found in a free condition, the presence, in any considerable quantity, of the sulphate of lime, for example, when corroborated by the corrosive effects proper to the acid, will leave but little doubt of its having been used. It should be remembered, also, that, if life have been at all protracted, the poison may have been eliminated in various ways. A case has been reported by Mr. Letheby, in which, during the first four days after an ounce of concentrated sulphuric acid had been swallowed, a large quantity was passed in the urine. This same fact has been established by Orfila, in experiments upon dogs.

According to these experiments:—

1st. In poisoning by sulphuric acid, it is sometimes possible to determine after several months and even years the presence of the concentrated acid.

2d. When the acid is very weak, it is found after some months saturated by ammonia, which has been disengaged by the putrefying matters, and, in this case, the presence of sulphate of ammonia, which may be found, does not necessarily prove that there has been poisoning by sulphuric acid, though certain probabilities of such poisoning might be established.

§ 353. *Stains on clothing.*—The stains on blue and black cloth, made by sulphuric acid, are at first red, and afterwards brown, and the stuff is corroded. The color of black leather is not altered, but the substance is partially destroyed. The stains on all textile fabrics remain moist for a considerable time if the acid have been strong, and, owing to the attraction of the acid for water, they have an unctuous feel. The acid may be detected in these stains after the lapse of many years. Dr. Taylor has detected it in spots made upon a black cloth dress *twenty-seven* years previously. The stains should be cut out, digested in distilled water, and then the liquid, after filtration, be tested by the reagents already mentioned. An unstained portion of the cloth should be submitted to the same test, since many articles of clothing yield slight traces of sulphates when boiled in water. Dr. Taylor has suggested a delicate test for sulphuric acid, founded upon its ready decomposition by organic matter when submitted to heat. About

half a grain of the stained dress (cotton) is put into a small test-tube, and gently heated; a piece of paper saturated with starch, and moistened with a drop of iodic acid, being held at the mouth of the tube, the blue iodide of farina is immediately produced by the sulphurous acid generated.(c) The only source of fallacy is the occasional presence of sulphur, as where mucus, serum, or blood may be mixed with the stain. Thus the test is inapplicable, for this reason, to woollen stuffs. The cloth may be boiled in distilled water, and the liquid can be tested by barium.

6th. *Aromatic sulphuric acid* (elixir of vitriol).—Besides sulphuric acid, this preparation contains alcohol and aromatics. The proportion of the acid to the alcohol is as 1 : 4.15 by weight (U. S. P.). In an overdose, it produces the same effects as sulphuric acid.

§ 354. 7th. *Sulphate of indigo.*—This is a solution of indigo in Nordhausen, or fuming, sulphuric acid. In addition to the other symptoms of poisoning by a corrosive liquid, the deep blue and subsequently greenish color of the vomited matter will at once betray the agent that has been used. In some cases the urine has had a bluish tinge.

II. *Nitric acid.* (Aqua fortis.)

§ 355. Concentrated nitric acid, as met with in commerce, varies in color from a light yellow to a deep orange red, owing to the presence of nitrous or hyponitrous acid, but the pure acid is colorless. Red fumes of nitrous acid gas are given off when a few copper filings are placed with nitric acid in contact with air. It stains organic matter yellow or brown.

§ 356. 1st. The *symptoms* produced by swallowing strong nitric acid do not differ essentially from those which have been already mentioned as caused by sulphuric acid. There is the same intense burning pain in mouth, throat, and stomach, the same violent efforts to vomit, and urgent constitutional symptoms. The lining membrane of the mouth is stained white, and then yellow or brown, and the enamel of the teeth is attacked. The soreness and swelling of the mouth and

(c) Taylor on Poisons, Am. ed., p. 180.

throat, the difficulty of swallowing and of respiration, the thirst and salivation, and the excessive pain and distress, are the prominent symptoms. If the person survive long enough, large portions of the lining membrane of the fauces and œsophagus become detached and are thrown up, together with altered blood and shreds of mucus. Similar matters may be discharged by stool. The *diluted acid* occasions the same symptoms in a more moderate degree. Although the immediate corrosive effects of the acid may be recovered from, death may occur subsequently from exhaustion and the injury done to the digestive powers. Dr. Black referred, in some remarks before the Royal Med. and Chir. Soc. of London, to the case of a girl who, "in a fit of despondency, swallowed some strong nitric acid. She left the hospital, but died many months afterwards, but so altered in appearance, that she resembled a woman eighty years of age. She was kept alive for seven weeks entirely by spring water." The œsophagus was nearly closed by the strictures which had resulted from the healing of the ulcerations produced by the acid.(*d*) The period at which this poison proves fatal varies, therefore, according to its dilution, from a few hours to several months.

Two drachms is the smallest quantity known to have destroyed life. This was nearly the quantity swallowed in a case reported by Dr. J. M. Warren. Death ensued on the fourteenth day. (It is stated that three drachms were taken into the mouth, but most of it was spit out.) Dr. Taylor refers to the case of a boy who died in thirty-six hours after taking *two* drachms of this acid. An instance, in which it was poured into the ear of a sleeping person, and caused death after some time, is related by Dr. Morrison.(*e*) Mr. James Haywood, a chemist, lost his life by inhaling the *fumes* of mixed nitric and sulphuric acids in consequence of the breaking of a carboy which held the mixture. The symptoms, which did not appear for more than three hours, consisted mainly of difficult respiration. Death took place in eleven hours. On examination, a considerable effusion of blood was found in the bronchial tubes, and their lining membrane and

(*d*) Lancet, 1850. (*e*) Dublin Journal, vol. ix. p. 98.

that of the trachea were congested. The larynx was not examined.(*f*) As in the case of other corrosive poisons, death from nitric acid may occur within a few hours (from two to twenty-four hours) or after several months, according to the quantity and strength of the acid, and the vigor of the patient.

§ 357. 2d. *Post-mortem appearances.*—The stains made by nitric acid upon the mouth and lips are usually of a deep yellow color; as these consist of a sphacelation of the lining membrane, they are easily detached and the subjacent surface is found even and glistening. If the person have survived several days, they may have been already cast off. The same appearance is found in the fauces, and more or less of it in the œsophagus. The stomach is softened, sometimes perforated, its internal surface is of a greenish-yellow, but sometimes of a black color, owing to the erosion of vessels and the effusion of blood, and the mucous membrane is ulcerated or destroyed. In Dr. Warren's case, the patient was a negress, who swallowed the poison with the hope of destroying her child, supposing that she was pregnant. She died on the fourteenth day. On dissection, there was observed great rigidity; upon the middle of the tongue, a large, yellowish, smooth patch; some redness of the epiglottis; the œsophagus was healthy for the first two inches, but below this it was found exceedingly soft, of a greenish color internally, purple externally, and full of coagulated blood. The stomach was in a similar though much worse state; externally, it had the same purple color, and was universally adherent to the neighboring parts by recent lymph, except at the left extremity, where there were old and close adhesions to the spleen; internally, it was of a greenish-yellow color, emphysematous, and so perfectly softened and pliable, that it could not be separated from the surrounding parts without giving way in every direction; the anterior face became detached from the rest of the organ to a great extent when the abdominal parietes were raised; its cavity was filled with recent

(*f*) Lancet, April, 1854, p. 429.

ted blood, and the open orifices of several vessels were
ly seen on the inner surface. The intestine contained
hroughout the first two or three feet, but was other-
iinjured.(*g*) In a case observed at the Hôtel-Dieu, at
the stomach was distended with gas, and perforated in
de sac; the opening, however, was partially plugged
spleen, which had become adherent over it, but which
vas much corroded. In the small intestine, there were
ius sloughs.(*h*) In another case, where the person sur-
he poisoning fifty-four days, the stomach was converted
vast abscess, with fungous walls made by adhesions
the adjacent viscera. The natural shape and structure
organ could no longer be distinguished.(*i*)

. 3d. *Chemical examination.*—Nitric acid may be readily
by its physical properties already mentioned, and by
fumes which are given off when it is poured upon
tin, or mercury in contact with air.

The *diluted acid* is not so readily detected as many other
Its compounds being very soluble, no precipitant can
d for it. Hence, it may be distinguished from muriatic
phuric acids by the absence of any reaction with the
s of baryta or silver. In order, however, to be able to
its presence, the following tests are recommended: The
should be neutralized with carbonate of potash, and
slowly evaporated. The crystals thus obtained are
of potash, and are prisms with dihedral summits in
m of lengthened fluted prisms, permanent in the air.
should be powdered and mixed with copper turnings.
is now applied, and moderately dilute sulphuric acid
the red fumes of nitrous acid become visible,
can easily be recognized by their odor. By this test,
ll a quantity of nitrate of potash as one-tenth of a
and, consequently, one-twentieth of a grain of nitric
ay be detected. This test is therefore quite satisfactory,

xtracts from Boston Soc. for Med. Improvement, Am. Journ. Med.
y, 1850, p. 36.
h. Jantet, Gaz. Méd. de Lyon, p. 82, 1852.
r. Delaharpe, Canstatt's Jahresbericht, für 1852, Bd. v. p. 101.

and others which are less perfect are rendered thereby unnecessary.

§ 359. (2) It may not, however, succeed where the liquid to be examined contains the *organic matters* resulting from the presence of food, or detached portions of mucous membrane. In this case, therefore, the liquid must be filtered to get rid of all insoluble substances, boiled with animal charcoal, and filtered a second time, or until it becomes tolerably clear. It should then be slowly concentrated by evaporation, and neutralized as before. As in the case of sulphuric acid, this acid may form other combinations in the stomach with the substances which have been administered as antidotes, and thus the difficulty of isolating it be increased. Or, again, the whole of it may have been vomited, or eliminated in other ways from the system. Fortunately, however, for the ends of legal medicine, if nitric acid prove fatal, the appearances upon dissection are so unequivocal as to render a chemical analysis hardly necessary.

§ 360. (3) *Stains on cloth.*—The spots made upon colored cloth by nitric acid are more or less yellow, but become brown after a time, the texture of the cloth is destroyed, and the spot, unlike that made by sulphuric acid, soon becomes dry. To determine the presence of nitric acid, the stain may be cut out and digested in distilled water. If the liquid have an acid reaction, it should be then neutralized with potash, and allowed to crystallize. The crystals may be examined as before, by heating with copper-turnings, and moistening with sulphuric acid. An unstained portion of the cloth should be examined in the same manner. Stains made by nitric acid will not furnish evidence of its presence after a few weeks have elapsed, the acid being much less permanent than the sulphuric. Hence, the necessity of proceeding at as early a period as possible to the examination of any suspicious stains upon a dress. Dr. Christison, however, has obtained evidence of the presence of the acid in stains on cloth made seven weeks before, and Dr. O'Shaughnessy after an interval of some months.(*j*)

(*j*) Guy's For. Med.

III. *Hydrochloric Acid—Muriatic Acid.* (Spirit of Salt.)

§ 361. 1st. *Symptoms.*—The reported cases of poisoning with this acid are few in number; but they present a strong analogy in their *symptoms and post-mortem appearances* with those of sulphuric acid poisoning. Immediately upon swallowing it there is a burning sensation from the mouth to the stomach, but especially in the throat, attended with a feeling of suffocation and followed by uncontrollable vomiting. Deglutition is almost impossible, all efforts to swallow bringing on vomiting; the voice is low and the respiration frequent and labored. The tongue and fauces are usually covered at first with a whitish pellicle, which afterwards becomes detached, exhibiting corroded spots underneath. In a case observed by M. Guérard,(*k*) a woman aged 24 years, who had swallowed about fifty-three grains of concentrated hydrochloric acid, presented the above symptoms. She however survived a considerable time. The matters vomited on the second night did not present any acid reaction, although no chemical antidote appears to have been administered. Death took place two months after the poison had been swallowed; and some time previous, portions of corroded mucous membrane had been discharged both by vomiting and by stool. Profuse salivation also was observed in this case, and in the beginning, white vapors were exhaled from the mouth. The same symptoms and the same prolongation of life were noticed in a case which became the subject of judicial investigation in Belgium, and which is commented upon by Orfila.(*l*) In two cases referred to by Dr. Christison, and in another, of a child, by Orfila,(*m*) death took place within twenty-four hours. In this latter instance, the acid was poured down the child's throat by its stepmother, as confessed by her after her condemnation. A case of recovery after swallowing an ounce of strong hydrochloric acid, is reported in the Lancet for 1850. In this case the stomach-pump was used, contrary to the usual caution enjoined in poisoning by mineral acids. A Hindoo, while intoxicated, swallowed

(*k*) Ann. d'Hygiène, tome xlviii. p. 415.
(*l*) Ibid., tome xi. p. 35. (*m*) Ibid.

about two ounces of hydrochloric acid, but rejected a portion of it by vomiting. Twelve hours afterwards he presented the following symptoms; the head was thrown backwards, the respiration frequent and moaning; the gums were pale and the teeth unaltered; the tongue also was pale, and, near its centre, deprived of its epithelium; the skin was cold, the pulse small and frequent, the epigastrium tender, and the urine scanty. There was neither vomiting nor purging. In twenty-four hours death took place, the mind remaining clear until the last. The urine contained a large proportion of hydrochloric acid.(*n*) In a case under the care of Dr. Budd, a woman 63 years of age died in eighteen hours from the effects of half a fluidounce of hydrochloric acid, taken with suicidal intent. Vomiting, collapse, whitening and abrasion of the lips, mouth, and fauces were observed; swelling of the throat and inability to swallow, with stridulous breathing and thick inarticulate voice, and intense epigastric pain were also noted. Death, without loss of consciousness until near the last, took place by exhaustion.(*o*) In May, 1859, a woman sixty-three years of age died at King's College Hospital, within eighteen hours after swallowing half an ounce of the strong acid.

§ 362. 2d. *Post-mortem appearances.*—These vary according to the length of time the person has survived, but bear a general resemblance to the effects produced by the other strong mineral acids. The digestive mucous membrane is covered with whitish superficial sloughs, which subsequently become of a darker color, and are found in all stages, lying loose or partly detached, and the mucous membrane inflamed, softened, or corroded. In some of the above cases, all the coats of the stomach were destroyed in spots, and perforations resulted. In Guérard's case, there was slight peritonitis. It is important, however, to note that the peritonitis, resulting from perforation of the stomach, only occurred in those cases which survived a long time. In Dr. Budd's case the force of the poison was spent upon the mouth, fauces, and larynx. The mucous membrane of these parts was whitened and softened, the soft

(*n*) Annales d'Hygiène, 2ème sér., ix. 209.
(*o*) Lancet, July, 1859, p. 59.

palate and tonsils swollen, and a portion of the lining membrane of the larynx was entirely removed.

§ 363. 3d. *Chemical examination.*—If any of the liquid which has been taken remain, it will be easy, if it is hydrochloric acid, to detect its nature, since the physical characters and chemical reactions of this agent are very striking.(*p*) It throws down, if sufficiently dilute, with nitrate of silver a dense, white, curdy precipitate of the chloride of silver, which assumes a violet color when exposed to light, and is completely insoluble in nitric acid, but dissolves readily in ammonia. Its detection, when mixed with organic matters, is not easy, owing to its tendency to adhere closely to them; but in medico-legal researches we are further exposed to the error arising from the presence, *normally*, of free hydrochloric acid in the stomach. As the quantity of this natural constituent of the body is subject to many variations, and since as much as four or five grains of the pure acid have been obtained from a pint of the fluid of water-brash, it is evident not only that the detection of free hydrochloric acid in a case of supposed poisoning is no evidence that it has been swallowed, but that it is extremely uncertain what quantity it would be necessary to demonstrate before we could feel satisfied that it was not normally present. In the Belgian case, before referred to, it was supposed by the chemists that they had established the fact of poisoning by this acid, although the person had survived two months; a subsequent analysis, however, of the stomach of a person of the same age, who had died of phthisis pulmonalis, gave precisely the same result. Moreover, if the mixture be neutral, it becomes necessary to use sulphuric acid

(*p*) The following means of detecting hydrochloric acid in cases of suspected poisoning has been suggested. (J. Bouis, Journal of Applied Chemistry.) Filter the liquid through linen and paper previously moistened with acetic acid, and then introduce a few crystals of chlorate of potash and some gold foil. Heat the whole over a water bath an hour or more, and the presence of the free acid is determined by the quantity of gold dissolved by the liquid. Chloride of tin may be used to detect even a few faint traces of gold which may have been dissolved. Diluted liquids should, before applying the above process, be concentrated by evaporation. A very few centigrammes of hydrochloric acid can be detected in a large quantity of liquid. The chlorides of sodium, potassium, and the like do not produce similar reactions.

to decompose the chloride which has been formed. But as chloride of sodium (common salt) is almost invariably present in the stomach, and is, indeed, a natural constituent of some of the secretions, the detection of hydrochloric acid will afford no indication of the manner in which it was introduced.

§ 364. For these reasons, the chief evidence of poisoning must be obtained rather from the symptoms during life, and the post-mortem investigation, than from a chemical analysis. We merely subjoin, to complete the subject, the following process when the matter to be examined is acid, taken from Dr. Christison's work on Poisons: "Boil it with water; if necessary, filter, and distil it with a gentle heat till the residue acquire the consistence of a very thin syrup. Subject the distilled liquor to the tests for diluted hydrochloric acid. It will seldom be found there, however, because it is apt to be retained by the coexistence of organic matter. If it be not found, add to the thin extract in the retort a slight excess of a strong solution of tannin, filter, and distil the filtered liquid by means of a hot bath of solution of hydrochlorate of lime (consisting of two parts of crystallized salt and one of water), taking care that the temperature of the bath never exceeds 240°, and stop the distillation just before the residuum becomes dry. Examine now the distilled liquor with the tests for diluted hydrochloric acid."

IV. *Oxalic Acid.*

§ 365. 1st. *Symptoms.*—Oxalic acid is one of the most rapid and certain of ordinary poisons. Its intensely sour taste generally prevents its administration with homicidal intentions; but is not always an obstacle to its being taken accidentally or for the purpose of suicide. Most of the accidents resulting from it have been occasioned by its being mistaken for Epsom salts.

§ 366. After the hot and sour taste in the mouth, vomiting is usually the first symptom, and is attended with burning pain and constriction in the throat and stomach, although it does not always occur, and in some cases the pain is absent. The vomited matters are dark-colored, and contain blood and some—

membranous shreds. When the pain is severe, symp-
of collapse come on rapidly, the extremities are benumbed
drawn up, the surface is cold, and the pulse irregular or
rceptible. A degree of stupor or drowsiness is sometimes
ved. The urgency of the symptoms depends upon the
ee of dilution in which the salt is taken. In a case
ed by Dr. Christison, no vomiting occurred for seven
s, except when emetics were administered. The person
taken half an ounce dissolved in ten parts of water, and
ed immediately afterwards with copious draughts of
r. In another case, a man swallowed an ounce, and im-
ately drank warm water; he was not seen until fourteen
s after he had taken the poison, and in the mean time had
elled a distance of ten miles.(*q*)

366*a*. 2d. The *rapidity with which a fatal result ensues* varies
eat deal. In some cases the action of the poison is ex-
ely rapid. Mr. Iliff reports a case in which death appears
ave been immediate. The wife of a chemist drank a
rated solution of oxalic acid in her husband's shop; she
found dead by the side of the counter, where she had
ably fallen and died without a struggle.(*r*)

r. Christison quotes a case in which a young man survived
lly *ten minutes;* another, in which a woman, who swal-
d two ounces, died in *twenty minutes;* and Dr. Taylor refers
case where death ensued in *three minutes.* The quantity
n in the last case could not be ascertained. Pereira also
tions a case which he examined, in which a man died in
ty minutes after swallowing oxalic acid in mistake for
m salts. Although death usually occurs within a few
s, cases are mentioned in which it was postponed for
ral days. Dr. Jackson reports one in which the poison
not prove fatal until the tenth day;(*s*) and in a case
ribed by Dr. Frazer, death occurred from its secondary
ts upon the twenty-third day. Some instances of recovery
eported. An interesting one was observed by Dr. Didama,
hich a woman dissolved two large tablespoonfuls of oxalic

(*q*) Lancet, Sept. 1845, p. 293. (*r*) Lancet, Oct. 1845.
(*s*) Bost. Med. and Surg. Journ., vol. xxxi. p. 17.

acid in mistake for Epsom salts, in a small quantity of water, and took it on an empty stomach. Some twenty minutes afterwards she vomited, at first the solution she had taken, and then a dark-colored, bloody-looking fluid, in which were numerous white membranous patches. Ipecacuanha and afterwards prepared chalk were administered to her, and in about an hour she was found quiet and nearly free from the intense burning pain in her stomach and throat. She subsequently vomited again, and discharged from her bowels a large amount of matter resembling that she had vomited. She soon recovered entirely, and returned to her work. A similar case, in which an ounce was taken, and the patient recovered in eighteen days, is reported in the Lancet ;(*t*) and a few others are referred to by Dr. Taylor.

§ 367. 3d. The only manner in which the *quantity capable of destroying life* can be approximately ascertained, is by reference to such cases as have proved fatal in the absence of medical assistance. The smallest quantity which has proved fatal under these circumstances is three drachms. It, however, by no means follows that a smaller quantity might not be attended with a fatal result, since some persons appear to have been far more seriously affected than others by equal amounts of this poison. This is proved by the case of a lad, sixteen years of age, who ate about a drachm of dry oxalic acid, and died in eight hours.(*u*)

The *binoxalate of potash*, salt of sorrel, or essential salt of lemons, produces the same symptoms as oxalic acid, and destroys life as readily. An instance is reported by Chevallier, in which death took place in *ten minutes*.(*v*) In another case, a third dose of a drachm and a half proved fatal in an hour.(*w*)

§ 368. 4th. *Post-mortem appearances.*—It is stated that death may ensue from oxalic acid, and yet no traces of its action on the alimentary canal be observable on dissection; this occurred in a case where an ounce had been taken.(*x*) This is certainly

(*t*) July, 1846, p. 39.
(*u*) Lancet, Dec. 1855, p. 521.
(*v*) Ann. d'Hyg. 1850, vol. i.
(*w*) Ibid. 1842.
(*x*) Lond. Med. Repos., vol. iii. p. 380.

not the ordinary result. According to Dr. Geoghegan, who examined the stomachs of three persons poisoned with this acid, the mucous membrane of the stomach was softened, with various shades of brown discoloration, and erosion or gelatinization; there was a brownish-black ramiform vascularity of the submucous tissue, and the contents of the stomach were of the color of coffee-grounds, owing to the action of the acid upon the mucus and coloring matter of the blood. In Dr. Jackson's case small ulcerations and thickening of the mucous membrane were observed, together with permanent redness. Hence the action of the acid may be chiefly expended upon the mucous coat of the stomach, no actual corrosion being observed. In an instance reported by Mr. Letheby, the coats of the stomach were so softened that it could scarcely be handled without lacerating it, and in another, referred to by Dr. Christison, it is said that this organ was perforated.(*y*) In some of these cases, however, it is evident that the conditions spoken of may have resulted from the long contact of the acid with the coats of the stomach after death, since even so feeble an acid as that naturally contained in the stomach is capable of producing similar results. It is certainly not the ordinary effect of oxalic acid. The œsophagus is also in many cases found altered, having a scalded or boiled appearance. It is pale, brittle, corrugated, and abraded in some places.

More recently a case has been reported by Dr. A. Wood, in which the stomach presented a large irregular aperture. As sufficient details of the dissection are not given, and the viscera do not appear to have been examined *in situ*, it is possible that this hole may have been artificially produced. The autopsy was made thirty-five hours after death.(*z*)

§ 369. A case of suspected poisoning by this acid was reported(*a*) in detail by Dr. J. C. White, of Boston, to the Society of Medical Science. The post-mortem appearances were as follows:—

Twenty-four hours after death the stomach, intestines, spleen,

(*y*) Med. Gaz., vol. xxxv. p. 49; Lond. Med. Repos., vol. xi. p. 20.
(*z*) Edinburgh Monthly Journal, March, 1852.
(*a*) Boston Med. and Surg. Journ., Jan. 27, 1870, p. 57.

kidneys, liver, and part of the pancreas were removed from the body and brought to Dr. White for examination, and forty-eight hours after death appeared as follows:—

The *stomach* which, with six inches of œsophagus attached, was tied at both extremities, contained ten or twelve ounces of grayish fluid of the consistence of gruel, with an acid smell and reaction. It was marked externally by dark streaks corresponding to the position of the bloodvessels, and by large stains of a scorched appearance near the œsophagus. Within, its lining membrane, for an inch or more surrounding the œsophageal opening, was of the same black color as that tube, and the bloodvessels in the depending portions filled with black blood were visible through it. Elsewhere, and generally, the mucous membrane was of its natural color or paler than usual. The structure of the mucous membrane and other tissues was unchanged except in the lower portions where it was soft and thin (probably a cadaveric change). There was more or less mucus attached to its inner surface.

The *œsophagus* exteriorly was of an uniform deep slate color. Its interior surface was stained of a deep black, the same color penetrating in parts to and through the muscular tissue. The lining membrane was not materially softened nor easily separated from the tissues beneath.

In the *intestinal canal* there was nothing unnatural besides the usual cadaveric softening of the mucous membrane and the reddened patches.

All the *other organs* were apparently healthy; the blood contained within them being generally bright red.

Christison states that after concentrated doses the "stomach is found to contain black extravasated blood, exactly like blood acted upon by oxalic acid out of the body."

In order to test further this action of oxalic acid upon the tissues of the stomach and œsophagus, the following experiments were made.

A healthy stomach was removed at an autopsy, and on the following day a solution of the acid (℥ss to ℥j of water) was poured into it and into the œsophagus, which was shut off from the stomach by a ligature. The next day the vessels of the stomach were seen externally to be blackened and the

darkened, the œsophagus being much darker than the
. The fourth day they were opened. The lining
ne of the œsophagus was much darker than that of
nach. The mucous membrane was everywhere white,
coats beneath were dark and had a scorched look in
On subsequent exposure the whole internal surface of
nach blackened at the tips of the *rugæ*. This latter
tance is interesting in connection with the fact that
els and sheet spoken of, in parts where stained by the
ges from the deceased, gradually turned to a dark
on drying, on the tops of the folds exposed to the air.
xperiment was repeated subsequently with a similar

an ounce of oxalic acid in one ounce of water was
by a tube into the empty stomach of a large and
pup, six weeks old. In a few minutes vomiting began,
s repeated several times. There was no purging. Six
fterwards there were remaining no symptoms of illness.
in twenty-four hours after killing showed the stomach
phagus pale and healthy ; there was nowhere any red-
or blackening of the tissues visible.
e same time a pup of the same litter, also strong and
, and in a fasting condition, had injected into the
the same quantity of the same solution, the œsopha-
ng tied just below the pharynx. Immediate attempts
it followed, which continued for some time. Death
ace in two to four hours. Section in twenty-four hours
rds. The stomach was found inflated with gas. Ex-
it was reddened in parts, and the bloodvessels of the
portion were visible and of a black color. It contained
colored liquid and mucus. The lining membrane was
d in parts and covered with a dark-colored mucus
emoved by the finger. Near the cardiac orifice it had a
own, scorched appearance, not to be wiped away. The
of the œsophagus was pale and generally stained of a
ackish color. These appearances resemble those pre-
in the stomach and œsophagus in this case. Oxalic acid
be detected in the blood, and if injected into a vessel

it is so readily decomposed that it cannot be recognized even after a few minutes.

§ 370. 5th. *Chemical examination.*—The crystals of oxalic acid resemble, at first sight, those of sulphate of magnesia (Epsom salts), and the former substance has hence often been taken in mistake for the latter. They are permanent, flattened, transparent, four-sided prisms, soluble in water and alcohol. They are also entirely volatilized by heat, which is not the case with sulphate of magnesia. [This is an important method of distinguishing oxalic acid from other similar crystals.] The usual tests for oxalic acid are *lime-water* and the soluble salts of lime, and *nitrate of silver*. With lime-water or even with a solution of the sulphate of lime, a white precipitate is obtained, nearly insoluble in an excess of oxalic acid, or in acetic acid, but readily dissolved by nitric acid. With nitrate of silver a copious white precipitate of oxalate of silver is obtained, soluble in nitric acid or in ammonia. If the precipitate be dried, and heated on the point of a knife over the flame of a spirit-lamp, it becomes brown on the edges, detonates feebly, and is entirely dissipated in a white vapour. In this manner it is distinguished from other white salts of silver, which give off white fumes, but leave a residue.

§ 371. In *liquids containing organic matter*, as in matters vomited or in the contents of the stomach, the preliminary steps of diluting, filtering, and concentrating are required. The liquid should be acidulated with acetic acid, and the acetate of lead added till the precipitate is no longer formed, for the purpose of separating the oxalic acid. If the resulting oxalate of lead be now diffused through distilled water, and a current of sulphuretted hydrogen be passed for a long time, (and until no more black precipitate is formed), through the liquid, a sulphuret of lead will be formed, and the acid remain in solution. It can then be examined by the tests already mentioned; and a portion of the liquid may be evaporated to form crystals of the acid. If, however, antidotes have been administered, such as chalk or magnesia, the supernatant liquid, after standing some time, may, if not acid, be thrown away, and the inorganic residue, after being suspended in distilled water, be mixed with a twentieth part of carbonate

ısh, and boiled for two hours. Thus oxalate of potash formed, which should be filtered and then neutralized il uted nitric acid. Add the solution of acetate of lead ; as any precipitate falls. Separate the oxalic acid by of sulphuretted hydrogen passed through the mixture late of lead, and test its presence as before. If the acid ot been entirely neutralized by the antidotes admin-, the supernatant liquid and the insoluble residue must rately examined.(*b*)

ust be remembered that if lime or magnesia has been ıs an antidote, the contents of the stomach may have a reaction, and the poison be contained in an insoluble ; in such an instance the local effects of the acid may so prominent, while enough of the acid may have been ed to cause death.

2. The tests for *binoxalate of potash* in solution are the ıs for oxalic acid. The crystals differ from those of acid in having a feathery appearance. They may be guished, also, by the action of heat, not being entirely ıted like those of oxalic acid, but leaving an ash of car- of potash. Both the quadroxalate and the binoxalate assa are kept in the shops under the names of salt of and essential salt of lemons, and are employed for re- g iron mould and ink stains from linen.

V. *Tartaric Acid.*

3. The only case in which this substance incontestably l poisonous is related in the *Lancet*, Jan. 2, 1845. A ook, by mistake for Epsom salts, an ounce of tartaric issolved in half a pint of warm water. He immediately ned that he was poisoned, and complained of a violent ıg pain in his throat and stomach. Obstinate vomiting ued for nine days, when he died. Nearly the whole of imentary canal was found highly inflamed. Tartaric

or some remarks on the facility of detecting oxalic acid by means of *roscope*, see report of a lecture on the Application of the Microscope cology, by Geo. W. Birkett, M.D., Med. Times and Gazette, April,

acid was detected in the dregs of the cup, and the druggist admitted that he had made a mistake. Another case is reported by Devergie, but the accuracy of his opinion and analysis is contested by Orfila. Christison mentions an instance in which six drachms of tartaric acid were taken in twenty-four hours, without the least inconvenience, and both he and Coindet administered it to cats without observing any injurious effect. An instance is on record in which the *bitartrate of potash* proved fatal by excessive purging, but the quantity swallowed, or rather *eaten*, is said to have been more than a quarter of a pound.(*c*)

VI. *Acetic Acid.*

§ 374. This acid in a concentrated form is highly irritant and corrosive. Only one fatal case of poisoning by it is reported. The liquid was swallowed by a young girl, and in a few hours afterwards she died in great agony. The post-mortem appearances resembled somewhat those produced by sulphuric acid, the surface of the tongue being brown and leathery, the mucous membrane of the œsophagus of a blackish-brown color, and large black elevations marked the lining membrane of the stomach, the rest of the organs appearing inflamed. Eight ounces of a thick, blackish fluid were found in the stomach. In case of an investigation to detect this acid in the contents of the stomach, it must be remembered, that it is contained in the natural secretions of this organ; hence, to be of any value, the chemical evidence must detect a considerable quantity of it. Also, as Christison suggests, vinegar is a common remedy with the vulgar for many diseases, and especially for poisoning.

§ 375. *Vinegar.*—Dr. David, of Montreal, met with an instance in which a woman endeavored to destroy herself by drinking a quantity of common vinegar. When seen, three hours afterwards, her countenance was wild and the pupils dilated, the body was covered with a cold perspiration, and the breathing was laborious and hurried. Her tongue was dry and cold, the abdomen distended, and she had acute pain in the

(*c*) Lond. Med. Gaz., 1837-38, i. 177.

epigastrium, which was increased by pressure. She was, moreover, delirious. She soon recovered after the administration of an emetic of sulphate of zinc.(*d*)

CHAPTER III.

IRRITANT POISONS(*e*)—(CONTINUED.)

ALKALINE.

Potash and soda, § 376.
Post-mortem appearances, § 377.
Bleaching solution containing, § 378.
Ammonia, and salts, § 379.
Baryta, § 382.

I. *Potash, Soda, etc.*

§ 376. THESE two alkalies may be treated together, since their poisonous effects are similar. Our notice of them will be brief, as they seldom occasion poisoning, and, when they do, it is almost necessarily accidental, and its cause is readily known. They may prove fatal either by their immediate action or by their remote influence upon the system. When swallowed in large quantity and in a concentrated solution, the taste is exceedingly nauseous and acrid, and a sensation of burning heat and constriction in the throat, œsophagus, and stomach is ex-

(*d*) Amer. Journ. Med. Sci., Oct. 1848, p. 302.

(*e*) Nearly all of the substances belonging to this class produce very different effects when they operate for a long time in minute quantities, and when they are taken in large doses at once. It is only in the latter case that the term irritant is strictly applicable to them. In the former mode of action they gradually undermine the health, and may ultimately destroy life by interfering with the nutrition of the body. This effect may result either from their deleterious action upon the digestive organs, or upon the composition of the blood, or finally upon an impairment of that action of the tissues by which they appropriate for their own nutrition the organic elements contained in the blood. Arsenic and most of the salts of mercury are actively irritant when applied to the tissues in a concentrated form; but in minute quantities, and largely diluted, they slowly but surely sap the foundations of life, by wearing away old structures and preventing the substitution of sound materials for their repair.

cited. When a considerable portion of the solution has reached the stomach, there is great pain and tenderness in the abdomen, vomiting of mucus and altered blood, inability to swallow, copious diarrhœa, and general collapse. If the patient survive a few days, the inside of the mouth is seen to be greatly inflamed, sloughs become detached from the throat, vomiting continues, there is a dysenteric condition of the bowels, and the patient dies from marasmus.

Life may be, however, prolonged even for months and years, and the person finally die from the impairment of his digestive powers or from a stricture of the œsophagus which prevents the swallowing of food in sufficient quantity to sustain life. A case is related by Dr. Barham, in which a caustic solution of impure carbonate of soda (soap lees) was swallowed by mistake, and the patient died two years and three months afterwards of stricture of the œsophagus caused by it.(*f*) Several other instances of a similar kind are recorded, and Sir Charles Bell relates one in which death did not take place until twenty years after the accident. A more recent example is one furnished by Dr. Deutsch.(*g*) The quantity drunk was a "portion of a glass," and was estimated to contain half an ounce of caustic potassa. The early symptoms were such as those described above, but recovery from them took place. Gradually, however, swallowing became difficult, and death took place in twenty-eight weeks after the accident. The lower part of the œsophagus was found enormously thickened, so that its canal was nearly obliterated near the stomach. The increased thickness was entirely confined to the mucous membrane, the muscular coat, on the other hand, having nearly disappeared.

II. *Nitrate of Potassa.* (Saltpetre.)

"A German, who spoke English imperfectly, went into a store, and asked for 'bitter salt,' meaning sulphate of magnesia (*bitter Salz*). The attendant supposed he meant saltpetre, and gave him half a pound. The man took three ounces and a half

(*f*) Lancet, 1850, vol. ii. (*g*) Times and Gaz., May, 1858, p. 537.

se. His bowels were opened three times within three ours. He complained of a slight sense of heat in the m, and drank a good deal of water. About five r having taken the saltpetre, he suddenly fell out of and died.

narked peculiarity, in this case, was the absence of l symptoms which usually follow the ingestion of oisons; and the question arises, how was death pro- Certainly not by inflammation of the stomach, for he d of nothing but a slight sense of heat in the stomach. n must have acted by destroying the vitality of the here was no post-mortem examination. The rigor s very imperfect, the lips of almost a natural pink the appearance of the countenance so life-like, that ons who were present doubted the propriety of inter- he third day."(*h*)

the largest dose of nitre which we find recorded as en taken, and its symptoms were, on that account peculiar. There are numerous instances of death l by an ounce or an ounce and a half of this salt, and the symptoms were those of a violent local irritant ressor, at the same time, of nervous power. Death r within two hours. On the other hand, recovery place after doses of nitre varying from half an ounce nces. The symptoms are vomiting, with extreme ain in the throat and abdomen, followed by coldness se, and subsequently by bloody stools. In one case omiting is noted.(*i*) Nervous symptoms, such as asm, and hallucinations, have been observed. Re- slow, and the digestive function remains feeble or

Post-mortem appearances.—The mucous membrane of ch will, in recent cases, be found more or less acted e salt. Thus it may be seen in some parts inflamed, ers covered with brown sloughs of partially detached . Perforation has even been observed. In chronic

(*h*) New Jersey Medical Reporter, Jan. 1855.
(*i*) Journ. f. Pharmakodynamik, ii. 178.

cases, the smooth and condensed structure peculiar to the cicatrization of mucous membranes will be easily recognized.

III. *Bleaching Solutions, etc.*

§ 378. Chloride of potash or of soda is frequently employed by washerwomen or laundresses, and hence, according to Tardieu,(*j*) quite a number of suicides and accidents have been caused by the swallowing of a liquid called *l'eau de Javelle* (chlorinated potassa), which is commonly used on account of its strong bleaching power on linens. In the dose of five to eight ounces this preparation can cause fatal results in an adult.

Chemical examination.—In seeking for the presence of these alkalies in the tissues there are two important considerations to be remembered: 1st. The rapid transformation of soda and potassa into carbonates when in contact with the air, the carbonic acid of which is absorbed and fixed by its oxides. 2d. The presence in the living organism of a certain number of salts of soda and of potassa which properly are contained in the secreting glands and other tissues. Up to this time no reliable means have been furnished for determining the presence of potassa and of soda in cases of poisoning by these alkalies.

Tardieu gives(*k*) the details of six different cases of poisoning by these caustic alkalies, in two of which *l'eau de Javelle* was the agent employed.

IV. *Ammonia and Sesquicarbonate of Ammonia.*

§ 379. This alkali has occasionally been used with homicidal purpose, but, in general, cases of poisoning by it are the result of accident. The vapor of strong ammonia has destroyed life, when respired too long a time by a person in a state of temporary insensibility. The effects produced by swallowing a strong solution of ammonia are somewhat similar, though more intense, than those of the other alkalies. Plenck relates that a man who had been bitten by a mad dog had adminis-

(*j*) Op. cit., p. 255. (*k*) Op. cit., p. 261, *et seq.*

tered to him a glassful of ammonia. His lips, tongue, and gums turned black immediately, and he died within four minutes.(*l*) In another case, strong ammonia was taken with suicidal intent. The symptoms were collapse, serous and bloody diarrhœa, and bloody vomiting, excruciating pain in the abdomen, and death in six hours. The mind remained clear till the last.(*m*) Two cases are reported in the same paragraph of children who were killed by accidentally swallowing a mixture of hartshorn and sweet oil.(*n*) A little boy, two years of age, took about half an ounce of very pungent spirits of hartshorn from a bottle. He immediately screamed and was very sick, bringing up at first stringy mucus of a light color, and then some more which was dark. The lips were swollen, the breathing was harsh, hurried, and somewhat obstructed, and afterwards became somewhat croupy. There was no insensibility nor any diarrhœa. He recovered.(*o*) In another case, reported in the same journal, an ounce was taken in milk, by a man who supposed it to be castor oil, having poured it out in the dark. He took immediately copious draughts of warm water, and vomited a quantity of matter like soapsuds. The inside of the mouth, upper lip, tongue, and fauces were white, and other parts excoriated; there was great difficulty in swallowing. He said he felt as if he was on fire from his stomach to his mouth; his voice was husky, pulse small and frequent, and the surface cold. He was ordered dilute acetic acid and demulcent remedies, under which he soon recovered. There was no diarrhœa throughout the case.(*p*) A woman took a wineglassful of strong liquor of ammonia by mistake for the acetate, yet in a fortnight she was convalescent.(*q*) Dr. W. Reed has reported the case of a man who swallowed by mistake three drachms of the strong solution of ammonia, and as much of the sesquicarbonate dissolved in two ounces of oil. The symptoms resembled those above

(*l*) Mitscherlich, Lehrbuch, ii. 277.
(*m*) Annales de Therapeut., iii. 443.
(*n*) Times and Gaz., June, 1855, p. 553.
(*o*) Iliff. Lancet, 1850, vol. i. 337, Am. ed.
(*p*) Ibid., 1852, i. p. 374.
(*q*) Wilkins, Lancet, 1846, i. 385.

described, but they subsided and were removed under appropriate treatment, in about eight days.(*r*)

Chevallier relates an instance of an attempt to poison with ammonia. The mistress of an officer, he being desirous of breaking up the connection, at their last proposed interview attempted to make him swallow a quantity of ammonia. A physician was sent for immediately. He found the lips excoriated, with phlyctenæ, and the tongue swollen and deprived of its epithelium, and the mouth and palate abraded. The throat was so sore as to prevent swallowing, and pressure on this and the region of the œsophagus was very painful.(*s*)

§ 380. 1st. *Post-mortem appearances.*—In a case related by Nysten, where a man died from the inhalation of the vapor while insensible, the nostrils were blocked up with an albuminous membrane. The whole mucous coat of the air-passages was mottled with patches of lymph. There was a black eschar on the tongue, and another on the lower lip. In general, the liquid form of this poison produces marks of violent inflammation, sometimes of the pseudo-membranous form, in the fauces and œsophagus, redness, softening, or ulceration of the gastric mucous membrane, and to some extent of the small intestine. The blood is generally liquid.

§ 381. 2d. *Chemical examination.*—Ammonia gives with bichloride of platinum, and with tartaric acid, the same reactions as potassa; the precipitates have also a similar composition. Ammonia is recognized with ease and certainty, even in the presence of all the other bases, by its being set free in a gaseous state by the action of the caustic alkalies, or of the alkaline earths, upon its compounds. For this purpose it is best to use *hydrate of lime.* Ammonia in the state of gas is distinguished by its peculiar smell, and by the white clouds which are formed when a glass rod, moistened with hydrochloric acid, is brought near the liquid to be examined. This appearance is owing to the formation of chloride of ammonium.(*t*)

(*r*) Times and Gaz., July, 1855, p. 59.
(*s*) Am. Journ. Med. Sci., April, 1854, from Gaz. des Hôpitaux.
(*t*) Will's Chem. Analysis.

V. *Baryta.*

382. The only two preparations of baryta which have ed fatal are the chloride and the carbonate.

Chloride of barium.—A student of medicine took three oonfuls of this salt in mistake for sulphate of magnesia. as seized with tormina and vomiting, his extremities ne cold, pulse irregular and feeble, and his hands and feet yzed. He recovered gradually in three days.(*u*) Two cases are referred to by Dr. Taylor, in which it proved .(*v*) A healthy young woman took less than a teaspoonful loride of barium, mistaking it for Epsom salts. In half our she had burning pains in the stomach and bowels, vomiting and purging, followed by the symptoms of pse above described, and a scarcely preceptible pulse, and by great impairment of muscular power, labored respi- n with bronchial effusion, coma, convulsions, and death, teen hours after the poison had been taken. Sensibility not seem to be impaired.(*w*) This salt seems to have a ed action in some cases upon the brain, producing vertigo, ache, deafness, and convulsions.

383. 2d. *Carbonate of baryta.*—This salt is also said to have oyed life in two cases.(*x*) In a case observed by Dr. son, of London, the quantity taken was half a teacupful, emetics were given and operated before any symptoms ed themselves. In two hours the patient complained of ness of sight, double vision, headache, tinnitus, and cramps, occasional vomiting and purging the next day. Recovery, ever, took place.

384. 3d. *Post-mortem appearances.*—In one of the cases of oning by chloride of barium before referred to, the stomach ented a uniform red appearance, with clots of blood and dy mucus scattered over it; near the cardiac end was a oration about half an inch in diameter within, and half as e outside, the edges swollen, and the mucous coat thickened. small intestines also exhibited signs of inflammation.

) Am. Journ. Med. Sci., Jan. 1852. From Casper's Wochenschrift.
) Taylor on Poisons. (*w*) J. Walsh, Lancet, Feb. 1859, p. 211.
) Parke's Chemical Essays, ii. 219.

Without doubt, as is remarked by Dr. Christison, the perforation was, in this instance, an accidental occurrence, not due to the chloride of barium.

§ 385. 4th. *Tests.*—Baryta is thrown down completely in the form of sulphate from all its salts, as well those soluble in water as those in acids, either by free sulphuric acid, or by any of the soluble sulphates. Most of the baryta salts impart a yellowish-green color to the flame of alcohol. The acids in combination may be determined by their appropriate tests; hydrochloric by the nitrate of silver, nitric by sulphate of potash, and acetic by the odor disengaged on the addition of dilute sulphuric acid. In order to separate the chloride of barium from an *organic* liquid, Dr. Christison says that the most convenient method is to dissolve any carbonate of baryta that may have been formed, by a little nitric acid, to filter, throw down all in the form of sulphate by the sulphate of soda, and then calcine the precipitate with charcoal. A sulphuret of baryta will then be procured, which is to be dissolved out by boiling water, and decomposed after filtration by muriatic acid. A pure solution, he says, is thus easily obtained. The chloride of barium, which is the salt most frequently taken, is soluble in water, and has an acrid, irritating taste.

CHAPTER IV.

IRRITANT POISONS—(CONTINUED.)

METALLOIDAL.
Phosphorus, acute poisoning by, § 386.
Chemical examination, § 389.
In organic mixtures, § 390.
Chronic poisoning by, § 391.
Bromine, § 392.
Iodine, § 393.
Chemical tests, § 395.
Chlorine, § 396.

I. *Phosphorus.*

§ 386. *The different forms and modes of administration of phosphorus.*—Phosphorus is administered under three different

es, in which the form only varies; phosphorus in a pure e (wax-like cylinders), phosphorus paste (used to kill rats), the inflammable cement used on matches. In ordinary tion matches the cement is made up largely of phosphorus a finely divided condition; in the so-called safety matches phosphorus is on the box. Phosphorus paste consists of ur, sugar, and fat, with phosphorus, ordinarily colored with ssian blue.

Red or amorphous phosphorus (heated in an atmosphere of bonic acid gas) is not poisonous.

§ 387. 1st. *Symptoms.*—These arise suddenly, but in most es not until some time after the poison has been swallowed. us in two fatal cases given below, they did not appear until en and twelve hours afterwards. They commence, as is ual with this class of poisons, with a burning heat in the mach and painful retching. There is great restlessness, rst, anxiety, and distress, with small, irregular pulse, cool remities, convulsions, and hippocratic countenance. In les priapism has been observed. The vomited matters are a black or dark-green color and have the odor of phosphorus, ich is like that of garlic, and this odor may also be per- ved upon the breath. The mode of death is sometimes et, with or without consciousness, but sometimes life ter- nates in convulsions.

d. The *quantity* required to destroy life is very small. The liest period at which death has taken place is four hours.(*y*) oung man died on the 12th day from the effects of a grain a half.(*z*) Martin-Solon relates the case of a patient who d in two days from less than a grain in the form of emul- n.(*a*) An apothecary named Doffenbach, in experimenting on the effects of this substance, took one grain, the next two, and the following day three grains; three days after last dose he was seized with violent vomiting, and died on seventh day.(*b*) A child two years and a half old died er swallowing the phosphorus on eight friction matches.(*c*)

(*y*) Journ. de Chimie Médicale, 1845, p. 580.
(*z*) Worbe, Med.-Chir. Zeit. 1826. Bd. 4, p. 183.
(*a*) Christison, p. 151. (*b*) Froriep. Notiz. Nr. 493.
(*c*) Schmidt's Jahrbücher, 1844. No. 6, Bd. xlii.

A child two months old is said to have died from the effects of two such matches.(*d*) If of the average quality, they would contain about $\frac{1}{16}$th of a grain of phosphorus.

A seller of matches, aged 22, half an idiot, and accused of theft, was so much affected by the charge that he determined to poison himself. From want of other means he took about two thousand matches, placed them in a pot filled with water, and boiled them. He swallowed this extraordinary decoction. In about twelve hours he was seized with vomiting, and brought up bilious and greenish matters, containing portions of the matches. When seen two hours later, his countenance was much altered, his body cold, and the pulse small and slow. The vomiting continued, and there was violent abdominal pain. The day after, the abdomen was swollen and fatal fainting fits occurred.(*e*) The matches used were of two kinds, one united with chlorate of potash, and the other with nitre and the peroxides of lead and manganese. It is probable that, in boiling, the phosphorus was converted into phosphoric acid at the expense of the chlorate or the nitre. A very analogous case is reported by Nitsche, of Vienna. A soldier swallowed the ends of six packets of phosphorus matches. Within three hours there was vomiting, followed by fever and headache. In the epigastrium there was slight tenderness and pain, which subsequently increased. The urine was albuminous, the bowels confined, and a profuse sweat exhaled the odor of phosphorus. The face, which at first was congested and red, except in the median line, which was pale, became cyanosed; the sight was lost, the pupils widely dilated and unaffected by light; the hearing was also lost; the extremities were cool and the second sound of the heart inaudible. At the end of the fourth day death took place tranquilly and without any previous loss of consciousness.(*f*) Another case from its degree of resemblance to the last two, deserves to be referred to in this place. A girl, twenty-two years old, took a portion of phosphorus scraped off from a small packet o-

(*d*) Husemann, Journ. f. Pharm. ii. 169.

(*e*) Am. Journ. Med. Sci., Jan. 1854, from Gaz. des Hôpitaux.

(*f*) Zeitschrift der k. k. Gesellschaft der Aertze zu Wien, and Am. Journ. Med. Sci., Jan. 1858, p. 290.

ucifer matches. Sharp pain in the abdomen was followed by vomiting of matters luminous in the dark, and subsequently containing blood. On the third day the pupils were widely dilated and but feebly sensible to light; on the fourth or fifth day there was drowsiness and impaired consciousness, followed by convulsions. Death occurred on the sixth day.(*g*) In another case a drunkard took half a cupful of phosphorus-paste, part of it being spread upon bread. Between seven and eight hours after this fatal breakfast, he had violent thirst, and a feeling of heat in the throat and stomach, which were soon followed by violent pain and continual vomiting. He died on the third day in horrible agony.(*h*)

A singular case occurred at Berlin, in April, 1859. A healthy child eight months old was left for half an hour in charge of a servant girl twelve years of age. It appeared that the ends of two friction matches were given by the latter to the infant, in order to quiet it. This not succeeding, the servant burnt one or more matches near the child's face, in order, as she averred, to amuse it with the flame. On the return of the parents the child was dead. Traces of corrosion were found in the stomach, but no phosphorus could be detected chemically. The more immediate cause of death was concluded to be congestion of the brain and lungs, or asphyxia, occasioned by the vapors of phosphorus cutting off the supply of atmospheric air.(*i*)

§ 388. 3d. *Post-mortem appearances.*(*i*[1])—In the case of the

(*g*) Lewinsky, Brit. and For. Med.-Chir. Rev., Oct. 1859, p. 529.

(*h*) Canstatt, Jahresbericht für 1851, Bd. iv. p. 264.

(*i*) Bünau, Casper's Vierteljahrs. xvi. 305.

(*i*[1]) It must be noted that the post-mortem appearances vary with the form of phosphorus used.

1st. When pure phosphorus has been used alone or in combination with fat or oil, the œsophagus and digestive canal are more often the seat of pathological alterations. "Fragments of solid phosphorus, recognizable by the odor or by the phosphorescence, have been found adherent to the mucous membrane of the intestines, and even in the large intestine." (Tardieu, op. cit., p. 437.) In the œsophagus and digestive canal may be found here and there ecchymotic or gangrenous spots. Generally the mesenteric ganglia are engorged, softened, and friable.

2d. When this poison has been in the form of paste or the substance used on matches, it will often happen that no appreciable anatomical lesion can

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drunkard mentioned above, the mucous membrane of the stomach was of a crimson color, softened in many places, and easily detached; near the pylorus was an ulceration of the size of a quarter dollar, with brown everted edges, and the muscular coat under it bare. Another similar ulceration was found in the greater curvature. The whole of the small intestine exhibited signs of violent inflammation, but the large intestine was free from it, except in the rectum. In the case quoted before this, the mucous coat of the stomach and duodenum was so softened that the handle of a knife, passed behind it, readily detached it in a dissolved condition. Similar conditions have been found in other cases.(*j*) These morbid alterations, therefore, resemble those of gastro-enteritis, arising from other causes. The agency of phosphorus in producing such changes must be ascertained not only from the history of the case, but also from its detection by the senses, and by chemical examination. Krahmer states that phosphorus after absorption so affects the blood as to produce ecchymoses under the mucous membranes, skin, etc.(*k*) It should, however, be borne in mind, that fatal poisoning by phosphorus may take

ever be detected, but ordinarily, if there be neither redness, trace of inflammation, nor ulceration, very many points of hemorrhage may be determined. On opening the abdomen, the mesentery and the visceral peritoneum appear spotted with black ecchymotic patches or points, analogous to the spots in purpura. The blood is liquid without any notable alteration of the blood corpuscles. The bladder incloses urine mixed with blood, and presents oftentimes submucous ecchymoses. (Ibid.)

The microscopical examination of the tissues is an important means of detecting poison by phosphorus. The liver, the kidneys, and the follicles of the stomach, the heart, and muscles are seen under the microscope in a condition of fatty degeneration. Still these peculiarities *per se* are not indicative of poisoning by phosphorus, as they are found after poisoning by many other agents, and also as the result of many diseases of the lymphatic system. These appearances must be associated with some of the important symptoms of phosphorus poisoning, as the *icteric* appearance of the body, muscular pains, and weakness. Tardieu (op. cit., p. 441) gives a representation by plates of the microscopical appearances mentioned above.

(*j*) In two cases, one of which was American, they were present in various degrees from light to dark injection, and thence to grayish and gangrenous ulceration. See Boston Med. and Surg. Journ., Nov. 1855, p. 323; and Nov. 1858, p. 343.

(*k*) Handbuch, 2te Aufl. p. 462.

place without the stomach, or indeed any of the organs, displaying the slightest lesion. This is shown in Nitsche's case, in which the dose of the poison was very large, in that quoted by Huseman,(*l*) in Lewinsky's case,(*m*) and others.

One of the most common alterations, and perhaps the most important of them, is a remarkable fluidity of the blood. Nitsche, Lewinsky, Krahmer, and Huseman, describe it. Of this point, Casper remarks, that we must admit phosphorus to be sometimes fatal by destroying the vitality of the blood. In the cases reported by him, the blood-disks had become transparent by the loss of their coloring matter which was diffused through the incoagulated plasma, giving it the appearance of a cherry-red fluid of syrupy consistence. Such changes prove the blood to be deprived of vital and nutritive qualities.

The contents of the stomach or the matters vomited may give a white inflammable vapor, and be luminous in the dark. This was observed in Lewinsky's case, referred to above. They may also exhale a phosphoric odor. Flachsland reported a case in which the dejections obtained by enemata were luminous in the dark, and pieces of phosphorus were found in them.(*n*) It is said that the intestines, and even the flesh of animals poisoned by phosphorus, have the odor of garlic, and appear luminous in the dark. In a woman who died while taking phosphorus medicinally, it was remarked that the whole of the viscera of the body were luminous; thus indicating the extensive diffusion of the poison.(*o*) Brera observed also, in opening the body of a woman to whom he had administered phosphorus both by the mouth and rectum, that a white vapor, having an alliaceous odor, and taking fire at the approach of a flame, arose from the stomach.(*p*) In the report of a case by Dr. Bingley, in 1857, it is said, " on opening the stomach there was an escape of white smoke, accompanied

(*l*) Journ. f. Pharm. ii. 169.
(*m*) Brit. and For. Med.-Chir. Rev., Oct. 1859, p. 529.
(*n*) Med. Chir. Zeit. 1826, iv. p. 183.
(*o*) Taylor on Poisons, p. 244.
(*p*) Riflessioni Med. Pract. sul'uso interno del fosforo, etc. Pavia, 1778, p. 8.

by a strong smell of garlic."(*q*) Similar vapors, luminous in the dark, have been seen issuing from the rectum and even from the vagina.(*r*) Another case is interesting from the fact that, although the body had been buried *fourteen* days, phosphorus was discovered by means of its physical properties, in the stomach.(*s*) On the *tenth* day after it had been taken Mayer detected it in the contents of the intestine.

§ 389. 4th. *Chemical examination.*—The appearance of phosphorus is familiar to every one. It is insoluble in water, but soluble in ether, alcohol, and the oils. It melts at 110°, and takes fire at a temperature a little above this. Sometimes it may be separated mechanically from the contents of the stomach, or from this organ itself. In a case of homicidal poisoning of a young actress in Berlin, the stomach was empty, there was no unusual smell, and only a few suspicious yellowish spots in the stomach, but no inflammation. In consequence of suspicions of the cause of death being aroused by the fact of the husband of the deceased having shortly before purchased phosphorus paste (under a special permit), the stomach was submitted to a chemical examination. Cut into pieces, and warmed in a dark place over a spirit-lamp, several shining points were observed in it, and afterwards, by directing a fine stream upon pieces of the stomach, removing fatty matters by boiling, and afterwards quickly cooling, the phosphorus was obtained in a globule of the size of the head of a pin.(*t*)

In another case of attempted poisoning, a woman prepared some soup for her husband. After he had taken a few spoonfuls, he was seized with pain in the stomach. In the evening his wife again pressed him to eat some more of it, but his suspicions were awakened, when, on taking it out of the warm and dark oven in which it had been put away, he observed that it was luminous. The bowl was therefore sent to the magistrate. On uncovering it, white vapors, with a penetrating odor, proceeded from it. When the contents were poured

(*q*) Lancet, June, 1857, p. 600.
(*r*) Casper, Gericht. Med. i. 401 and 442.
(*s*) Schäffer, quoted in Henke, Zeitschrift, 1851. E. H. 43, p. 215.
(*t*) Schacht, Casper's Vierteljahrs. 1852. April.

out on an evaporating dish, a transparent, shining globule was observed at the bottom, and afterwards several more, which, when rubbed between the fingers, became luminous, and gave off white vapors. On boiling the soup over a spirit-lamp, bubbles rose to the surface, which inflamed spontaneously.(*u*)

The detection of phosphorus is, however, seldom so easy. Being mostly taken finely divided in the form of paste, and being not always rapidly fatal, it may have been either removed by vomiting, or exist in too small quantity to be recognized with certainty. Nevertheless, as we have before stated, it has been detected in the body fourteen days after death. In another case, it was found ten days after death.(*v*) And it is probable that in competent hands it may always be recognized, if really present.

§ 390. Various processes have been recommended for the detection of phosphorus in *organic mixtures*. The simplest plan is to evaporate partly the organic mass, and then place portions of it upon a heated iron plate. The phosphorus will then take fire, and burn with a yellow light and white smoke. If the quantity of phosphorus be very minute, this trial will still detect it, since, according to Orfila, it is applicable, even when the phosphorus forms but one-thousandth part of the mixture. Schacht recommends its separation by sulphuric ether; the details of this process will be found appended to the case above reported by him. The usual mode is to convert the phosphorus into phosphoric acid, by boiling in nitric acid. After evaporating to dryness over a water-bath, and slight dilution of the residue with water, a solution of nitrate of silver will produce in it, if previously neutralized with ammonia, a yellow precipitate. Another portion may be converted into hydrated phosphoric acid, by heating the residue, after evaporation, to redness. This, when cooled, may be dissolved in a little water, and will give, after being previously neutralized with ammonia, a white precipitate with the nitrate of silver. Care must be taken not to regard as an evidence of

(*u*) Henke's Zeitschrift, E. H. Bd. xxvi. S. 173.
(*v*) *Vide* Henke, loc. cit.

poisoning, the presence of phosphoric acid and of phosphates, which may have been derived from the food, or produced by certain diseases.

This process is not sufficiently precise in its results to be employed in criminal investigations, for the question is not whether phosphorous acid or phosphoric acid existed in the stomach, but whether this organ contained phosphorus itself. The former belong to the natural constituents of the body, the latter does not.

The most certain mode of discovering phosphorus in organic mixtures, such as the stomach usually contains, is that employed by Mitscherlich.(*w*) The suspected liquid is contained in a flask with sulphuric acid and water, and on being heated, its vapors rise through a small glass tube, at first vertically, then horizontally, and finally downwards. The descending limb of the tube is enveloped to a certain height with a cold water bath, penetrating which it passes into a closed vessel below. As the vapors, in coming over, reach the cool portion of the tube, they are condensed, and become luminous in the dark. By this method, five ounces of a substance containing only one-fortieth of a grain of phosphorus, afforded three ounces of distillate in the course of half an hour, during all of which time the luminous zone was visible.

If the mixture subjected to distillation contain alcohol, ether, or oil of turpentine, no luminosity would be observed so long as these substances distilled over. Alcohol and ether being very volatile would soon be separated, and the light would then appear; this would not be the case with oil of turpentine, which substance would rarely be present in a medico-legal examination. Neither tartar emetic, magnesia, iron oxide, musk, castor opium, albumen, any of the metallic salts, volatile organic acids, nor free acids would interfere with the luminosity. Iodine, calomel, corrosive sublimate in large quantity, metallic sulphides, and particularly oil of wormseed will interfere with the luminosity. (F. Hoffman, in London Chem. News, Jan. 1861.) Dr. Schöm detects phosphorus in organic and inorganic substances by mixing the anhydrous

(*w*) Casper's Vierteljahrs. viii. 6.

powder with magnesium filings, and heating the mixture for some time in a test-tube. If now a few drops of water are added, phosphuretted hydrogen is given off and recognized by its onion-like (alliaceous) odor; a sublimation of red phosphorus and a phosphorescence is often observed, if magnesium is used in somewhat larger proportion; ammonio-phosphate of soda, burned bones, etc., show this reaction well.(*x*)

§ 391. *Chronic poisoning* by phosphorus is a disease engendered by this substance in persons who are employed in its manufacture. Its principal organic lesions are caries and necrosis of the bones, with abscesses of the soft parts, added to which the digestion becomes impaired, and, after prolonged vomiting and diarrhœa, life is destroyed by hectic.(*y*)

II. *Bromine.*

§ 392. From the constant use of *Bromine* in daguerreotyping, accidents may readily arise from it. It is a dark-red liquid, of a strong and unpleasant odor, and acid taste. Its vapors, which are given off at ordinary temperatures, are exceedingly injurious both to the eyes and to the lungs. According to Mr. Wurtz, it is highly destructive to organic matter. He placed a human stomach, with its contents, in a porcelain dish, covered it with water, and poured upon it an ounce of bromine. By the aid of a gentle heat, and occasional stirring with a glass rod, the stomach had entirely disappeared in *less than half an hour.*(*z*) Its corrosive properties have been heretofore observed only in animals.

The only case on record of fatal poisoning by bromine in man, has been reported by Dr. Sayre, of New York. A. H., aged twenty-four, of good health and temperate habits, a

(*x*) Journal de Pharmacie, 1869.

During the last few years many cases have been reported in the different medical journals, where the oil of turpentine has been successfully used as an antidote for phosphorus poisoning. One of these cases is reported in detail by *Andant* in the Bulletin Générale de Thérapeutique, tome lxxviii. p. 169.

(*y*) Accounts of this affection have been given by various authors, among whom may be mentioned Tardieu, Times and Gaz., Oct. 1856, p. 352, and Leudet, Arch. Gén. de Méd., Avr. 1857, p. 308.

(*z*) Silliman's Journal, N. S., vol. vi. p. 405.

daguerreotypist by profession, residing in Williamsburg, near New York, swallowed one ounce, by weight, of bromine, for the purpose of destroying himself. The immediate symptoms, as reported by his medical attendants, were spasmodic action of the muscles of the pharynx and larynx, and great difficulty of respiration. This was soon followed by intense burning heat in the stomach, with great anxiety, restlessness, and trembling of the hands. The pulse was rapid, tense, and corded, and the respiration greatly hurried. The stomach was entirely empty at the time of the taking of the bromine. Various means were used, unsuccessfully, for his relief, the symptoms above described increased in intensity; the hands and feet became cold, with failure of the pulse, etc., until two P. M., when he died, *seven and a half hours* after taking the poison.

The post-mortem examination was made seventeen hours after death. On opening the abdomen, the external surface of the stomach was found vividly injected, as was also the peritoneal coat of the duodenum, and of the mesentery. A portion of the latter nearest the stomach was stained of a deep yellow color, as were also other parts lying immediately beneath the stomach. A softened ecchymosed spot, an inch and a half in diameter, and several others of a smaller size were also found upon the peritoneal coat of the stomach. The stomach contained about four ounces of thick fluid, resembling port-wine dregs, and exhaling faintly the odor of bromine. Its whole internal surface was covered with a thick black layer, resembling coarse tanned leather. The mucous membrane was very thin, and there was intense submucous injection.(*a*)

Bromine may be separated from *organic mixtures* by agitation with ether or bisulphide of carbon, which dissolve it. If a bromide has been formed, a few drops of a solution of chlorine should be added, to set the bromine free.

III. *Iodine.*

§ 393. 1st. *Symptoms.*—This substance is capable of acting in a deleterious manner upon the system, under two circum-

(*a*) New York Journ. Med., Nov. 1850.

stances, viz., by the long-continued use of small doses, or by the administration at once of a large quantity. The symptoms occasioned by its too prolonged use are incessant vomiting and purging, pain in the abdomen, heat and dryness of the throat, headache, rapid emaciation, violent cramps, and a general febrile condition. A patient of Zink, a Swiss physician, after taking too large doses of iodine for about a month, became restless, had burning heat of skin, tremors, palpitation, very frequent pulse, violent priapism, copious diarrhœa, excessive thirst, emaciation, and occasional syncope. He died, after an illness of six weeks. Salivation is also an occasional result of the prolonged use of iodine. A case is related in which one drachm of the tincture of iodine, in about an ounce of spirit, is said to have proved fatal.(*b*) Very often, however, large doses of this substance are productive of no evil effects, nor are unpleasant results generally experienced from its prolonged administration. Dr. Christison quotes a case, in which a child, three years old, took three drachms of the tincture, and suffered only from thirst and slight vomiting. Dr. Kennedy, of Glasgow, gave to a girl 953 grains of iodine, in the form of tincture, during eighty days, without any effects upon the health; and Mr. Delisser gave thirty grains a day to a patient, without any injury resulting.

§ 394. 2d. *Post-mortem appearances.*—In the case related by Zink, redness of the intestines, in some places approaching to gangrenous discoloration, was the chief morbid alteration observed.

§ 395. 3d. *Chemical tests.*—Iodine is usually met with in the form of soft micaceous scales of a grayish black color, metallic lustre, acrid hot taste, and disagreeable odor. It is sparingly soluble in water, but is readily dissolved by alcohol or ether. The best test for it in a free state is starch, as a very minute proportion of this substance will give a blue color to a solution of iodine. This blue color is destroyed by heat; hence in testing, the liquids employed should be cold. If iodine is combined with a base, it must be first set free by nitric or sulphuric acid. It may be detected in the blood and secretions of a patient under its use.

(*b*) Prov. Journ., June, 1847, p. 356.

4th. *Iodide of potassium*, although milder in its effects, is otherwise similar to iodine in its operation upon the system, and is usually preferred as a medicinal agent.

IV. *Chlorine.*

§ 396. Orfila has shown, by experiments upon animals, that a saturated solution of chlorine in water produces effects similar to those of the mineral acids. No instances of its poisonous effects upon the human subject are recorded.

CHAPTER V.

IRRITANT POISONS—(CONTINUED.)

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I. *Metallic Arsenic.*

397. METALLIC arsenic is known under the name of mine-kobbolt (or "mineral devil," a name given by German miners), fly poison, and fly stone. It has a bluish-gray frac-

ture and a metallic lustre, and, by exposure to the air, becomes gradually black, and loses its lustre. It is easily pulverized, and has neither taste nor smell. Exposed to heat, it gives out an alliaceous odor, and in the atmospheric air its vapors are changed into the white vapor of arsenious acid. It is readily oxydized by mineral and vegetable acid; it thus acquires poisonous properties. Accidental death is not uncommon from its use. A case is mentioned (*Bost. Med. and Surg. Journ.* vol. xxx. p. 17) in which a child, two years of age, died in consequence of taking it by mistake.

A highly interesting case of homicidal poisoning with it has been reported by Dr. Schütte.(*c*) It is, we believe, with one exception, the only one on record.(*d*) The wife of a barber, named Dombrowsky, was suddenly attacked, on the morning of the 11th of April, with violent vomiting and purging, with pain and heat in the epigastrium, and excessive thirst. A physician was called to visit her in the evening, but, being ignorant of the cause of the attack, prescribed simple remedies. She had no fever, her pulse was slow and soft, and the abdomen was not tender upon pressure. The vomiting, and especially the purging, still continued; and although they afterwards abated, her strength sank rapidly, and she died on the sixth day. On the third day after death an examination of the body was made. There was not found any natural cause of death. But, on opening the stomach, it was observed to have no putrefactive smell; it was red in streaks, and the mucous membrane was softened. There were also several hemorrhagic erosions, especially in the neighborhood of the cardiac orifice. Some small black particles having a metallic lustre, were seen upon it. These were carefully detached, washed with distilled water in a porcelain capsule, and then reduced on charcoal by means of the blowpipe. They gave out the well-known garlicky odor. The same odor was perceived when some were put in a reduction tube and exposed to heat, and both an arsenical crust and the small white octahedral crystals of arsenious acid were obtained. Evidence of

(*c*) Casper's Vierteljahrschrift, Oct. 1854.
(*d*) Briand, Méd. Lég. 452. (7th edition.)

the presence of arsenic was also obtained by the usual liquid tests. By Marsh's apparatus, arsenic was detected in the fluids contained in the stomach, and the amount obtained from this, and from the subsequent analysis of the stomach itself, was computed at nineteen grains. Additional circumstantial evidence, which fixed the crime upon the husband, was derived from the examination of a few particles of a shining black powder found in the extreme end of his pocket, and also from the analysis of the dried spilled contents of a cup of sago, which, intending to give to the deceased, he had placed in the stove to warm, but which had been cracked by the heat. It was also proved conclusively that he had himself purchased, at several times, portions of arsenic and of kobbolt, which were found in the house. This fact, it may be remarked, was clearly brought home to him by the commendable provision of the Prussian code, which requires that a person purchasing poison shall give a receipt therefor to the apothecary, containing his name, address, the date, and also the alleged purpose for which it is required. These receipts were produced upon the trial. The prisoner was convicted chiefly upon this and the admirable and minute chemical investigation, and sentenced to be beheaded.

§ 398. The forms of arsenic most used in poisoning are: *arsenious acid*, *arsenites*, the so-called *chloride of arsenic*, *arseniate of potash* or *soda*, the *sulphides of arsenic* (*red sulphide* or *realgar*, the *yellow sulphide* or *orpiment*), the *arsenite of copper* or *Scheele's green*, and others. They all produce similar symptoms.

II. *Arsenious Acid.* (Arsenic; White Arsenic.)

§ 399. The poison which is generally known under the name of arsenic, or white arsenic, is an oxide of the metal, and has a slight acid reaction, whence it is called arsenious acid. It is met with in one of two forms, either as a white, vitreous, crystalline substance, or as a white opaque and granular powder. It is sparingly soluble in cold water (about one in fifty parts), but is more freely dissolved by boiling water, which takes up the acid in about the proportion of one of the

acid to ten or twelve of water.(*e*) Dr. Taylor found, by numerous experiments, that a fluidounce of hot water took up, in cooling from the boiling point, nearly one grain and a quarter of white arsenic, but that if boiled for an hour on the poison, and allowed to cool, the water held dissolved about twelve grains to the ounce. In some experiments made by Schroff upon the solubility of arsenious acid, he found that one part of the acid in 480 of water, the liquid being frequently shaken, was not fully dissolved in fourteen days. He boiled one part of arsenic with 100 of water, and found that complete solution took place after fifteen minutes' boiling.(*f*) It is even less soluble in liquids containing organic matter. The different statements with regard to its solubility possibly depend upon the difference in this respect between the crytalline and the opaque powder. Its *taste* is not, as was formerly represented, acid, but, on the contrary, is, when at all preceptible, rather sweetish. It is sometimes described as bitter, usually rough, etc. As a general rule, it may be stated that it is without taste, except when in solution, when the taste perceived may be faint and sweetish. The sparing solubility of this substance is the cause of its want of taste, and also explains the fact why, in the majority of cases of poisoning by it, it is found in larger or smaller quantity in the matters vomited, or adhering to the mucous coat of the stomach. Its solubility is increased by the presence of an alkali or an alkaline carbonate.

§ 400. *Symptoms.*—The symptoms occasioned by poisoning with arsenic do not always manifest themselves immediately upon its ingestion, and this is particularly the case when the poison has been introduced into some article of food or drink, and taken at a meal. Still they may occur immediately. A child, three years old, drank from a saucer some arsenious acid mixed with milk. It was seized *immediately* with pain, vomiting, and diarrhœa.(*g*) In the case referred to by Dr. Taylor, the symptoms were proved to have attacked the

(*e*) Will's Analysis.
(*f*) Canstatt's Jahresbericht for 1853, Bd. v. p. 52.
(*g*) Henke's Zeitschrift, E. H. 43, p. 150

deceased while he was in the act of eating the cake in which the poison was administered. In the case of Sager, tried in the State of Maine, in 1834, quoted by Beck,(*h*) extreme distress was *immediately* experienced after taking the poison.

§ 401. Generally the symptoms are not perceived until a later period, which is usually stated at from half an hour to an hour after the poison had been swallowed. On the other hand, they have been, in some cases of poisoning with arsenic, delayed in an unaccountable manner. In a case related by Dr. Ryan, where half an ounce of arsenic was taken in porter, the first symptom, which was vomiting, did not occur until nine hours afterwards. Mr. Clegg was called to see a girl who had taken a teaspoonful of arsenic, but who was supposed also to be addicted to the use of opium. Seven hours after she had taken it she appeared stupid, as if intoxicated, but no further symptoms of irritation occurred until near noon of the following day, when, although she had been cheerful all the morning, and was engaged in preparing dinner, she was suddenly seized with excruciating pain in the stomach, and died in half an hour, about twenty-four hours after taking the poison.(*i*)

§ 402. Authentic instances are on record in which there has been also an intermission in the regular progress of the symptoms. Thus, in the case of the girl Davidson, reported by Dr. Maclagan, the vomiting diminished on the fourth day, was trifling on the fifth, was absent on the sixth, but returned, accompanied by purging, on the night of the seventh. It is stated that there could not have been a repetition of the dose. So also in the case of McVey, by the same author, the man was taken ill with the symptoms of irritant poisoning about half an hour after eating an oat "bannock." Although he appeared to be very ill in the mean time, he was not again seized with vomiting until the morning of the fourth day, and died three days thereafter. "It did not appear that anything had

(*h*) Vol. ii. p. 546.

(*i*) Lancet, vol. ix. p. 31. A case is also related by Belloc, in which *ten hours* elapsed after the taking of the poison before any symptoms showed themselves; the vomiting was then slight, as also the pain in the abdomen, and no mention is made of the occurrence of diarrhœa. She died as from the effects of a narcotic poison. Cours de Méd Lég., p. 122.

been given him which would have contained a fresh dose of the poison."(*j*) Dr. Christison says: "A short remission, or even a total intermission, of all the distressing symptoms has been witnessed, particularly when death is retarded to the close of the second or third day. This remission, which is accompanied with dozing stupor, is most generally observed about the beginning of the second day. It is merely temporary, the symptoms speedily returning with equal or increased violence."

§ 403. The symptoms usually begin with a sensation of sickness, and a burning heat in the stomach. There is also a sense of constriction and heat in the throat, with great thirst, and violent efforts at vomiting soon take place. The substances vomited have no peculiar color, as this depends both upon the matters that happen to be present in the stomach, the antidotes administered, and the length of time the vomiting continues. When the stomach is empty, mucus streaked with blood, and yellow or greenish bile will communicate a color to the contents of the basin. If powdered arsenic have been swallowed, it may sometimes be recognized in the ejected matters by its white and flaky appearance. The irritation of the poison being communicated to the lower bowels, diarrhœa usually supervenes, and is frequently thin and bloody and attended with much straining and distress, and cramps in the calves of the legs. When the latter symptoms are urgent, they are usually attended with an inability to pass the urine. These symptoms all increase in gravity till near the close of life. The general system also sympathizes with the disturbance of the digestive organs; the countenance is collapsed and anxious, the extremities and the surface generally ice-cold, the pulse almost imperceptible, the respiration accelerated, the voice oppressed, and convulsions, delirium and stupor not unfrequently usher in the closing scene. Such is a picture of the ordinary train of symptoms in a case of poisoning by arsenic.

§ 404. It should be understood, however, that they are liable to many variations, and authentic cases are related in which the symptoms resembled, to a certain extent, those of narcotic

(*j*) Edinb. Month. Journ., Jan. 1853.

poisoning. The system appears in such cases to be completely overpowered by the toxical effects of this substance, and the most extreme faintness or depression is the most prominent symptom. The pain in the abdomen and the vomiting are occasionally not urgent, except towards the close of life. These variations, when occurring in persons addicted to the use of opium or of ardent spirits, may be partially accounted for, but often they must remain unexplained.(*k*)

§ 405. When, however, instead of one dose sufficient to destroy life, or several doses at short intervals, capable of producing this effect, the poison is given in small portions at comparatively distant intervals, the symptoms are not so marked in their succession, and are attended with phenomena different from those already described. The following may serve as an example: "A woman put daily into the soup of her fellow-servant a very small quantity of arsenious acid in powder. Shortly after dinner, this person was seized with vomiting which led to the rejection of the food and poison before the latter had caused any serious mischief. As this practice was continued for about six weeks, the stomach grew exceedingly irritable; there was pain in the bowels, and the woman became much emaciated. There was also spitting of blood, with such a degree of nervous irritability, that a current of air caused an attack of spasms and convulsions. When the patient found that she could not bear anything on her stomach, she left the place and passed two months in the country. Her health became gradually restored there, and she returned to resume her usual occupations. The prisoner, however, renewed her attempts; and, to make sure of destroying her victim, gave her one morning, in coffee, a strong dose of arsenious acid in powder; violent vomiting ensued, and the poison was expelled with the breakfast. Arsenic was detected in the vomited

(*k*) For cases illustrating these points, *vide* Christison on Poisons. Also, an interesting case by Dr. Ogston (Med. Gaz., 1851). In this there was headache, stupor, feeble pulse, cold extremities, nausea, and tonic and clonic spasms. Vomiting did not occur until several emetic doses of sulphate of zinc had been given, and then only two hours and forty minutes after the arsenic, amounting to three drachms, had been swallowed. The poison was discovered in the blood, liver, and contents of the stomach, the patient having lived six days.

matter, and the explanation of the cause of the long previous illness became clear. Under proper treatment, the patient recovered."(*l*) Christison relates a case somewhat similar, which, however, was not so protracted, and which terminated fatally.(*m*) It was by this means, probably, that the crime of secret poisoning was carried in the seventeenth century to such a fearful extent. The miserable woman who vended the liquid, called after her, *Aqua Tofana*, confessed at her death that she had destroyed by it no less than six hundred persons. It is generally supposed that its active ingredient was arsenious acid.

§ 406. Those who have partially recovered from the immediate effects of arsenical poisoning, are, moreover, liable to the secondary effects, above referred to: salivation, chronic intestinal disorder, palsy, dropsy, and an irritative fever soon prostrate the vital powers, and the fatal termination, although sometimes slowly attained, is, in the majority of cases, none the less certain. The period at which death supervenes cannot be definitely stated with reference either to these cases or to those of acute poisoning. In the latter it usually takes place within twenty-four hours; it may be postponed for several weeks or months. The average period in twenty-two cases reported by Dr. Geoghegan, was seventy-seven hours and a half, the shortest was five and a half hours.(*n*) Cases are, however, known, in which death has taken place within two hours.(*o*)

§ 407. Arsenic is equally noxious when *inhaled* in the form of vapor, or applied *externally* to a denuded surface, or upon the mucous membrane of the *vagina* or *rectum*.(*p*) Its effects

(*l*) Taylor on Poisons, from Flandin, p. 257.

(*m*) Loc. cit., p. 250, Am. ed.

(*n*) Dublin Quarterly Journ., Feb. 1851.

(*o*) The following case will be found in the Lancet, Oct. 1845, by Mr. Iliff: "E. D——, the servant in a family, after placing the dinner on the table, retired to her chamber, and drank a glass of water, in which she had mingled as much arsenic as it would dissolve; *she fell directly and died instantly;* no struggling whatever took place. I saw these two cases (referring to another published at the same time) almost immediately after the poison was taken."

(*p*) *Vide* Christison on Poisons.

emely rapid when it is inhaled, but when it is absorbed
wounded surface the symptoms usually do not occur so
when it is swallowed. Being an ingredient in most
astes used by cancer-curers in the extirpation of scir-
easts, it is by this means not unfrequently introduced
system, and has produced death with all the symptoms
ical poisoning. Even the small proportion of arsenic
contained in the stearine of some candles, has, when
r has been used for the purpose of dressing a blistered
produced nausea, pain in the stomach, thirst, redness
ongue, spasms of the muscles, weakness and irregu-
the pulse, and death within twenty-four hours.(*q*)

l cases are quoted by Christison from Fodéré and
here arsenic given by injection into the rectum proved
d introduced into the vagina caused death in less
enty-four hours. It is said, moreover, to have pro-
olent symptoms when applied to the unbroken skin,
used as a depilatory.

A case of death from the external application of
o the head of a child two years of age, affected with
avosa, is related by Dr. McCready, of New York. A
btained about half an ounce of arsenic, and, mixing
gin, rubbed it well into the heads of several of her
affected with this disease. It was followed by redness
ling of the face; in the child alluded to, however, it
diarrhœa and tenesmus, with paralysis of the lower
ies, but no signs of local inflammation. The mother
at she had on one previous occasion applied the
and, though the application was followed by some
this soon subsided, and the head seemed much

Dr. Mitchell, of Liverpool, relates a case in which
istic constitutional symptoms, as well as severe local
tion, were produced by applying a mixture of arsenic
oap to the pubes and axilla for the purpose of destroy-
ulæ.(*s*)

(*q*) Med. Gaz., 1842–43, p. 351.
(*r*) Am. Journ. Med. Sci., July, 1851, p. 259.
(*s*) Lancet, Aug. 1857, p. 127.

§ 409. As arsenic has been and is now extensively employed in the arts, cases of acute and chronic poisoning by this agent have been by no means rare. Oxide of arsenic, or black native arsenic, sometimes called kobbolt, a substance used in France as a fly-powder, always contains a very considerable proportion of arsenious acid.(*t*) Arsenic green, such as Scheele's, Scheinfürt, vert anglais, employed as a pigment in the manufacture of paper-hangings, artificial flowers, for dyeing cloths, muslins, etc., are arsenites and arseniates of copper.(*u*)

Aniline-red or *fuchsine* (made by cooking in an oil-bath a mixture of aniline and arsenic acid), and anileine (made by treating fuchsine with alcohol and an excess of aniline), have shades of color varying from azure-blue to violet-red. Marsh's test for arsenic will give from crystals of fuchsine metallic spots.(*v*)

Orpiment, yellow sulphide of arsenic, enters into the composition of depilatory preparations for the removal of hair-moles and spots from the skin. Realgar is the red sulphide of arsenic, and is likewise used as a depilatory in combination with quicklime. Quacks often use escharotic pastes and powders for the removal of cancerous tumors and sores, which are generally composed of arsenious acid mixed with other active substances.(*w*) There is a soap (called *savon de Bécœur*) employed by taxidermists for the preparation of skins, which contains thirty-two per cent. of arsenious acid.

§ 410. Taylor, of London, and Tardieu, of Paris, state that no dose can be fixed upon which will assuredly cause death to man, and the latter also mentions(*x*) that this question loses its importance in practice, for in cases of criminal poisoning or of suicide it is very rare that the dose of arsenical poison

(*t*) Tardieu, Étude Medico-legale sur l'Empoisonnement, Paris, 1867, p. 318.

(*u*) For an account concerning the "evil effects of arsenic in certain green colors," see the third Annual Report of the Mass. State Board of Health, 1872.

(*v*) Littré et Robin, Dict. de Médecine, etc., Paris, 1865, p. 630.

(*w*) Some of these preparations are described in *l'Officine*, Dorvault, Paris, 1866, p. 748, under the head of Poudre Arsenicale Escharotique.

(*x*) Op. cit., p. 322.

swallowed does not exceed the quantity necessary to cause death, and that it does not attain 5 to 10 or 15 grammes (one-third of a grain to a grain).

§ 411. In 1854 Dr. Tschudi published an account of the Toxicophagi of the lower countries of Austria and Styria. These persons were in the daily habit of taking large doses of arsenic, with the effect of improving the freshness of their complexion and becoming more active and free in respiration.(*y*) When this practice was suddenly discontinued, emaciation and gastric disturbance ensued.(*z*) It is well known that horse dealers give horses small quantities of arsenic, either mixing it with their oats or attaching a piece of linen inclosing a small fragment to their bits, and with the effect of improving the appearance of the animals. The accounts given by Tschudi and Vogt (*a*) have been opposed by Pereira, Christison, and others, especially Taylor,(*b*) who cites reasons why the fact of arsenicophagism, true or false, can be of no practical value to the medico-legist. Prof. La Rue (*c*) gives an interesting account of a man who was in the daily habit of eating and smoking arsenic without producing any but favorable symptoms. In the presence of the professor he swallowed three grains of pure arsenious acid, then a minor dose weighing a grain and a half. Another half grain he smoked, mingled with his tobacco, filling the laboratory with the odor of garlic. He the next day swallowed four grains of arsenious acid, and on the day following was perfectly well and free from any gastric disturbance.

§ 412. *Post-mortem appearances.*—The only reliable and tolerably constant changes produced by arsenic in the healthy appearance of the viscera, are found in the stomach and intestines. The mucous membrane of the stomach is usually of an uniform deep brownish-red color, sometimes it is ecchymosed in patches, and at others there are spots or streaks of effused blood. These often have the appearance of crusts, and,

(*y*) Wiener medizinische Wochenschrift.
(*z*) Med. Times and Gazette, London, July, 1854, p. 66.
(*a*) Med. Jahrb. des öster Statts, 1822, i. 99.
(*b*) On Poisons, London, 1859, p. 91.
(*c*) Boston Med. and Surg. Journ., June 28th, 1866, p. 439.

being of a blackish color, are not unfrequently mistaken for gangrenous patches, and the slight depression under them for ulceration. But neither ulceration nor gangrene is an ordinary result of simple arsenical poisoning; if found, these are probably merely concomitant lesions, dependent upon other causes.(*d*) Perforation is exceedingly rare. Orfila says that he has never observed it.(*e*) The mucous membrane is also frequently swelled and thickened, possessing in some parts a fungoid appearance, and its structure is more frequently condensed than softened, owing possibly to a chemical union between the arsenic and the albumen. The powder, if the poison have been taken in this form, is often found imbedded between the folds of the mucous membrane, and closely adherent to it in brilliant points, or in white and flaky patches. The matters contained in the stomach are evidently too variable in character to be enumerated, since the ingestion of different liquids, and of the many so-called antidotes which have been given in most cases, naturally destroys the possibility of drawing any useful inference.

§ 413. *The period of time* requisite to develop the inflammatory condition of the stomach is altogether a matter of conjecture, since the mucous coat of the stomach has been found inflamed when death has followed the poisoning at only the short interval of two or three hours; and, on the other hand, where the quantity swallowed and the duration of life have been such as to lead to the natural belief that inflammation would be discovered, the stomach has been found nearly or entirely free of any such morbid change. Indeed, in a few cases the arsenic has been observed in immediate contact with the gastric mucous membrane, without any signs of inflam mation. Nevertheless, as a general rule, the inflammatory appearances will be found developed in proportion to the pro-

(*d*) In the Lancet for Sept. 1843, it is reported that the body of a man poisoned by arsenic was disinterred 141 days after death. The stomach and intestines were in perfect preservation. About the middle of the small intestine was found a small ulcerated opening, through which some of the white powder was detected, similar to what was found in the stomach, and which proved to be arsenic.

(*e*) Méd. Lég., vol. iii. 330.

traction of the case. In a case reported by Dr. Letheby, the stomach was of a pale color. Ettmüller reports the case of a girl in whose stomach arsenic was found, and yet neither in it nor in the intestines was there a trace of inflammation.(*f*) Orfila, in his work upon legal medicine, says: "The existence or non-existence of cadaveric lesions, the extent and seat of these alterations, can never enable us to affirm that poisoning has taken place, but can only serve to corroborate the conclusions drawn from the symptoms and the chemical examination of the suspected matters." These remarks are confirmed by observations of Marc and Chaussier.(*g*) The inflammatory appearances seldom extend further than the duodenum, although sometimes the small intestine and the rectum exhibit evidence of inflammation. In general, there are no other post-mortem changes at all characteristic of this mode of death. The blood is said to be often syrupy in consistence.

§ 414. The introduction of arsenic into the system by external application is usually followed by the same alterations in the stomach and intestines as when it has been brought into direct contact with the mucous membrane of these viscera.

In medicinal doses, the solution of the oxide of arsenic produces sometimes serious symptoms, and cannot be increased without at once causing symptoms of poisoning. The medicinal dose is from one-sixteenth to one-twelfth of a grain, and half a grain is sufficient to produce very alarming symptoms. Physicians are accustomed to watch the accession of conjunctivitis, swelling of the face, gastrodynia, and general depression, as indications of the dose being too great or too frequently repeated.

§ 415. The facts relative to the effect of *arsenic upon the putrefactive process* are of a very contradictory character. A number of cases are quoted by Dr. Christison, which appear to prove a remarkable antiseptic property in arsenic, by which not only the digestive organs, but the whole body, has been preserved from the ordinary changes of putrefaction. There

(*f*) Encyclopæd. der gesammt. Med. von Schmidt, 1848, Arsenik-Vergiftung, S. 166.

(*g*) Orfila, Méd. Lég., vol. iii. p. 329; also Toxicologie, vol. i. p. 316.

is no doubt of the preservative quality of an arsenical solution over organic textures placed and kept in it, and the experiments made by Klenck upon dogs seem to show that in cases of poisoning, also, this property may be witnessed. This physician poisoned dogs with arsenic, and left them for two months, sometimes buried in a damp cellar, sometimes unburied in the same place, and the flesh and alimentary canal were red and fresh, as if pickled, at the end of this time. Dr. Kelch, of Königsberg, buried the internal organs of a man who had died of arsenic, and whose body had remained without burial till the external parts had begun to decay, and on examining the stomach and intestines five months after, he found that the hamper in which they were contained was very rotten, but that they had a peculiar smell, quite different from that of putrid bowels, were not yet acted on by putrefaction, but as fresh as when first taken from the body, and might have served for the purpose of anatomical specimens. The body of Chapman, supposed to have been poisoned by Mina, was disinterred two months after death. The face was livid and putrid, but the odor of the corpse was not offensive. The abdomen was of a pale-white color, and Dr. Hopkinson, on cutting into it, was struck with its firmness and resistance. When the stomach was opened, a very peculiar smell was perceived, which he compares to that of pickled herring. The same remark was made by other medical witnesses.(*h*) The intestines were entirely empty, of a pale color and apparently rather disposed to dry than to putrefy. In a case communicated by Dr. Traill to Dr. Christison, the body of a captain of a vessel was disinterred five months after death. The face and neck were swollen, black, and decayed, but the rest of the body was quite free from the usual signs of putrefaction. The skin was white and firm, the muscles fresh, the lungs crepitating, the liver and spleen much shrivelled, the stomach and intestines entire throughout their whole tissues, and capable of being handled freely without injury. In this instance the

(*h*) In two cases of poisoning by arsenic, observed by Dr. Sanborn, of New Hampshire, the same peculiar odor was distinctly observed. Bost. Med. and Surg. Journ., vol. xxxvii.

coffin contained water, owing to its having lain in a sandy soil resting on clay. The remarkable preservation of the body of a woman supposed to have been poisoned by arsenic, for nearly *fourteen* years after her death, led to its disinterment, the indictment and trial of her husband. Arsenic was found in the body.(*i*)

§ 415*a*. On the other hand, Dr. Geoghegan has observed examples both of very tardy and of very rapid decomposition in cases of arsenical poisoning.(*j*) It would not be difficult also to find many cases in which, although death has resulted from other causes, the body has been as remarkably preserved as in those where arsenic was the cause of it. We have elsewhere enumerated the various causes which will retard putrefaction, as the dryness of the soil, and the depth at which the body has been interred, as well as individual peculiarities, which do not always admit of explanation. We may quote here an observation which will show, that, even under the most favorable circumstances for decomposition, this process may proceed very slowly. This is a case communicated by Dr. Routier, of Amiens, to Orfila, in which an old woman was destroyed by a blow upon the head with an axe. This was in the middle of summer. The body lay buried in a clayey soil of a cellar between eight and nine months. At the end of this time, a judicial inquest was held. The skin was perfect, the muscles firm, red, and distinct, the cerebrum was like that of a fresh corpse, and possessed its natural firmness and proper odor. The viscera of the chest and abdomen were perfectly well preserved; and in the stomach, which presented no signs of inflammation or other disease, a thick fluid was found in which the remains of articles of food were distinctly recognized.(*k*) The fact of the remarkable preservation of the brain in this case is also of some importance, for it is well known that usually it putrefies rapidly, and because also of a case lately reported by M. Dieu, where the body of a man poisoned by *arsenic* was disinterred after the lapse of two years and a half,

(*i*) Webster, Bost. Med. and Surg. Journ., vol. xxxix. p. 489.
(*j*) Dub. Quart. Journ., Feb. 1851.
(*k*) Orfila, Traité de Méd. Lég. 4ème ed., vol. ii. p. 93.

the comparative integrity of the brain was attributed to the preservative powers of this substance.(*l*)

Hence the medical witness cannot be authorized to assert that, because the body has resisted more or less completely the progress of putrefaction, this preservation is due to arsenic, since it may be really attributable to other causes. One cause of the discrepancy in the observations upon this point undoubtedly lies in the variable time occupied by the poison in producing its fatal effect, and the nature of some of the symptoms. It is reasonable to suppose, and observation also has shown, that, if death have resulted from the ingestion of the poison at repeated intervals, in small doses, or not until several days have elapsed, the arsenic has been disseminated through the system, and may thus exercise a more complete antiseptic influence in the dead body. If, again, the person has died within a short period after taking the poison, and after abundant and repeated vomiting and purging, we may be right in anticipating, that, although the violent action of the poison has been the cause of death, little or none will have remained in the body. Hence, in the latter case, putrefaction will probably pursue its ordinary course. Thus, in a case examined by Dr. Geoghegan, of a person who died sixteen days after taking a large dose of arsenic by mistake, no trace of the poison could be found in any part of the body.(*m*)

§ 416. *Arsenic found in the body.*—It is fortunate for the ends of justice, that arsenic may be discovered either in the stomach, or extracted from the viscera, at a long period after death. It was found by MM. Ozanam and Idt, after the long interval of seven years. In a still more recent case, it was discovered after ten years. A man named Eichel fell sick on the 15th of February, 1842, after eating his supper, and died on the evening of the 17th. Ten years and four months afterwards, in consequence of some testimony respecting the mode of his death, the body was disinterred, and a chemical analysis instituted. The body was reduced nearly to the bones, although the brown and curly hair was still present.

(*l*) Ann. d'Hyg., Jan. 1854.

(*m*) Med. Times and Gaz., April, 1857, p. 389.

The bones were covered with a greasy, gluey substance, on which were numerous pasty spots of a yellowish-white color. The body gave out no smell. The ligaments no longer held the bones together, and the ribs and clavicles had fallen in. A dark greasy mass indicated the remains of the viscera, and in the abdominal organs as much as *ten* grains of arsenic were detected by chemical examination. The wife of the deceased was condemned to death at Magdeburg, in 1853.(*n*) Dr. Webster, of Boston, succeeded in finding four grains of arsenic by chemical analysis, in the body of a woman alleged to have been poisoned by this substance *fourteen* years previously. The case was tried in Boston, in 1848, the husband of the deceased being the accused party.(*o*)

When arsenic in substance has been taken, it does not always remain in the condition of the white oxide, but frequently becomes converted, by the sulphuretted hydrogen developed during decomposition, into the sesqui-sulphuret, which is of a yellow color. It may undergo this change in a short time after death. Dr. Taylor has found it as early as twenty-eight days after death. In the language of Dr. Christison, "it is the effect of a chemical test applied to the poison by nature."

Arsenical poison in the alimentary canal resists decomposition longer than the organs themselves, and remains in the residuary organic matter. If it is in the viscera or in the tissues where it has been conveyed by absorption, it is still less liable to be drawn out of their close network. As long as a particle of the poisoned corpse remains, it preserves the poison, and it is only the complete destruction of the body that places a limit to the research and attestation of arsenical poisoning.(*p*)

(*n*) Casper, Vierteljahrsch. 1854, No. 2. The case in detail is found in Bley's Archiv für Pharmacie (II. Bd. lxxv. Hft. 2, Hanover, 1853). See also the same journal (April, 1855) for an interesting report of a case in which a woman was accused of poisoning her father, brother, and sister, and in which arsenic was found in the remains of the three murdered persons after a lapse of eight weeks and *seven* and *eight* years respectively. Hardly anything but the bones remained in the two last mentioned. The accused made a full confession some time after her sentence.

(*o*) Boston Med. and Surg. Journ., vol. xxxix. p. 489.

(*p*) Tardieu, op. cit., p. 376.

§ 417. *Chemical examination.*(q)—Arsenious acid, in its chemical relations, must be considered, 1st, as a solid; 2d, in solution; 3d, mixed with organic matter.

(1) *As a solid.*—It is entirely volatilized by heat. Thrown upon ignited charcoal, it gives off an aliaceous odor, which is due to the reduction of arsenious acid to the sub-oxide, the arsenious acid having in itself no odor when heated; the smell of garlic is only perceived when it is deoxidized. This odor, although striking, is not a positive proof of the presence of arsenic, as a similar one may be given off by several other substances. If, however, we heat arsenious acid with dry acetate of potash, oxide of kakodyl is disengaged, by the peculiar insupportable smell of which compound even very minute traces of arsenious acid may be detected. This experiment may be conveniently performed by rubbing the substances together in a little mortar, and then heating them together in a test-tube, allowing the vapor, which is excessively poisonous, to be carried away by a current of air.

§ 418. Heated in a narrow test-tube, or in the reduction-tube of Berzelius, with some freshly ignited (cold) charcoal, the same phenomena of deoxidation and evolution of odor occur as when it is placed on red-hot cinders in the open air; but in this case metallic arsenic is condensed by sublimation upon a cool portion of the tube, in the form of a metallic crust or ring, of an iron-gray color, brilliant and lustrous upon the outer surface, and crystalline upon the inner when seen under a low magnifying power. There are usually two crusts deposited, an upper and a lower, the latter of metallic arsenic,

(q) It hardly seems worth while to collate a chemist's manual for the determination of arsenic. The methods of analysis vary so much from year to year that confusion would result from combining an account of all the methods of analysis. The ends of justice are met far better by the counter testimony of two chemical experts, than by the severe cross-questioning by a person whose knowledge of chemistry is more theoretical than practical, more the result of a hasty investigation of poison manuals than a thorough knowledge of his subject. Hence, for a more complete knowledge of the chemistry of arsenic reference may be made to Bowman's Medical Chemistry; Rose, Handbuch der Analytischen Chemie; Fresenius, Quantitative Chemical Analysis; Manuel Complet de Médecine Légale, Briand et Chaudé, Micro-Chemistry of Poisons, Paris, 1869, Wormley; etc.

and the other of a browner color, which is a mixture of the metal and its oxide.

§ 419. The arsenical nature of the ring may be further proved by volatilizing it by heat, in an open tube, by means of the flame of a spirit lamp; it is thus converted into arsenious acid, which sublimes upon the tube in the form of octahedral crystals, which may be dissolved in distilled water, and subjected to the liquid tests; or by dissolving them by means of nitric acid, and evaporating the solution to dryness, *arsenic* acid is formed, which is known by its giving a brownish-red precipitate, with nitrate of silver. When the quantity of arsenic is considerable, it is better to use a flux composed of the residue left by tartrate and acetate of soda, after incineration in a covered platina crucible, as recommended by Dr. Taylor. The volatilization of the crust may be accomplished either by applying heat directly to it, and chasing it up and down in the tube until it is all oxidized, or by carefully filing off that part of the tube in which it is contained, powdering it, and then introducing it into the end of another tube, which should in turn be subjected to heat.

The metallic crust of arsenic may, moreover, be distinguished from the discoloration produced by *charcoal*, by the absence, in the dark stain of the latter, of any metallic appearance; the inner surface of the charcoal discoloration being powdery, black, and dull. The possibility of error should, however, be guarded against, by the careful introduction of the charcoal into the tube through a funnel with a long stem.

§ 420. The sublimate obtained by the reduction of the *compounds of mercury*, as calomel or corrosive sublimate, has indeed a metallic appearance, but may be distinguished, without using the liquid tests, by an inspection with a common lens, or even with the eye; the minute globules of metallic mercury can thus be readily seen, and by the point of a knife be made to run together. The objections that have sometimes been made to the reduction process, on the grounds that *glass* contains arsenic or lead, are theoretical only. Glass does not contain arsenic, for although used in its manufacture, it is entirely volatilized by the heat required in the process, and when the glass does really contain lead (which ought not to

be the case in suitable chemical implements), the mere loss of transparency caused thereby upon the application of heat, is evidently in the substance of the glass itself, and cannot, with the slightest attention, be mistaken for the arsenical crust.

§ 421. Moreover, the discoloration caused by the reduction of lead will be in the part of the tube to which the flame is applied. A crust weighing only a three-hundredth of a grain, a tenth of an inch broad, and four times as long, may show characteristically all the physical characters of an arsenical sublimate a hundred times larger. It may, therefore, be safely laid down that the appearances exhibited by a well-formed arsenical crust contained in the minute quantity of the three-hundredth of a grain are imitated by no substance in nature which can be sublimed by the process for the reduction of arsenic.(*r*)

(2) *In solution.*—The liquid tests for the detection of arsenic in solution are three in number. They are applied to clear solutions of arsenious acid free from organic matter, and are extremely useful in corroboration of the tests by which it is obtained in a metallic state; the arsenical deposit having been first converted into arsenious acid by sublimation in an open tube.

§ 422. (*a*) *Hydrosulphuric acid.*—In the presence of free acid (hydrochloric), hydrosulphuric acid throws down the tersulphuret of arsenic, which is of a *lemon-yellow* color. This precipitate is soluble in ammonia. Dried, and heated with carbonate of soda in a reduction tube, a metallic sublimate of arsenic may be obtained.

§ 423. (*b*) *Ammonio-nitrate of silver.*—This test should be carefully prepared. (To a strong solution of nitrate of silver add a dilute solution of ammonia, until the brown oxide of silver which is thrown down is nearly but not entirely redissolved. When properly prepared, there should be no free ammonia given off.) The *arsenite* of silver, which is precipitated by this reagent, is of a *lemon-yellow color*, which is soluble both in ammonia and nitric acid. It must be noticed that phosphate of soda also produces, with nitrate of silver, a similar

(*r*) Christison.

precipitate, which is equally soluble in nitric acid and ammonia.(*s*)

§ 424. (*c*) *Ammonio-sulphate of copper.*—(This test is prepared in the same manner as the foregoing. No more than is actually necessary for precipitation should be used, as its intense blue color is very apt to mask the proper color of the precipitate. If, however, this has occurred, filtration will separate the *green arsenite of copper* from the uncombined portion of the liquid.) The color of the precipitate is a *chrome green.* When dried, and heated in a test-tube, arsenious acid is disengaged, and sublimes on the sides of the tube in the characteristic crystals, leaving a residue of the oxide of copper. Their nature may further be proved by dissolving them in distilled water, and submitting them to any other of the tests which may be desired. In relation to this test it must also be borne in mind that a similar precipitate is produced when the solution of copper is added to liquids containing some vegetable substances, though no arsenic may be present.(*t*)

§ 425. The fallacies to which these tests are exposed are the following: Phosphoric acid gives a yellow precipitate with ammonio-nitrate of silver, exactly like arsenious acid; several organic acids cause a green precipitate with the copper test, and the soluble salts of cadmium yield, with sulphuretted hydrogen or hydrosulphuric acid, a yellow precipitate, similar in appearance to the sulphuret of arsenic. But doubts arising from these sources as to the true character of the precipitate may be corrected by a comparison of the tests and the production of a metallic or crystalline sublimate. Thus, phosphoric acid gives only a pale-blue precipitate with the copper test, and is not affected by sulphuretted hydrogen; and the *pseudo*-arsenical precipitate obtained by cadmium with sulphuretted hydrogen, or by organic acids with the copper test, when dried and heated in a reduction-tube, gives neither the metallic deposit, such as is obtained from the sulphuret of arsenic, nor the crystalline sublimate as obtained from the arsenite of copper. "No one in the present day would think of employing these liquid tests in solutions in which arsenic

(*s*) Bowman and Bloxam. London, 1871. (*t*) Ibid., p. 82.

was mixed with organic matter. Almost all liquids used as articles of food are precipitated or colored by one or both of the above tests, somewhat like a solution of arsenic, although none of this poison may be present. An exclusive reliance upon them, as *color-tests*, has led to the rejection of chemical evidence on several trials."(*u*)

§ 426. (3) *Mixed with organic matter.*—It should be remembered that the liquid tests are not applicable directly to liquids containing *organic matter.* The same colors which have been mentioned as indicating with probability the presence of arsenic may be obtained in liquids used as articles of food, containing common salt or various colorless organic acids. Hence, unless the precipitate obtained can be made to yield arsenic by the other tests, there can be in an organic liquid no demonstration of its presence; the only method, therefore, free from objection, is to use the liquid tests in *aid* of the other processes of Marsh and Reinsch, or in liquids not contaminated by the various organic matters which may be present in the stomach, or remaining from the poisonous drink administered.

We have been favored, by Dr. Jackson, of Northumberland, with a reference to a case(*v*) in which chemical evidence of this kind would have procured the indictment of a faithful and exemplary wife for the murder of her husband by poisoning with arsenic, had it not been for his interposition; he showed not only that the man did not die with the symptoms of arsenical poisoning, but that the chemical investigation was both imperfect and fallacious.

The following is an extract from the minutes of one of the examiners: "The contents of the stomach—about sixteen ounces, and principally fluid—were thoroughly mixed by agitation and stirring, and successive portions submitted to the following tests: A small portion was put into a clean Florence flask, to which about four ounces of *common* water and a few grains of subcarbonate of potash were added; this was submitted to the heat of a spirit-lamp until boiling commenced. Portions of it were poured into two clean wine-glasses, to one

(*u*) Taylor on Poisons. London, 1859, p. 389.
(*v*) Am. Journ. Med. Sci., Nov. 1829, p. 243.

of which a small quantity of sulphas cupri was added; this had the effect of changing the fluid, which had been of a light-hazel (owing to the color of the contents of the stomach), to a light-green color, resembling that of Scheele. To the surface of the other glass a stick of lunar caustic was applied; the effect was an immediate *white cloudy* appearance, which soon changed into a reddish-yellow or orange color, and, after standing a few hours, resolved itself into a reddish-brown. * * * The next day, the remaining contents of the stomach having been dried, half an ounce of the suspected matter was boiled with snow-water in a flask until it rose to the top of the vessel; the fluid was suffered to cool, when a stream of sulphuretted hydrogen gas was passed through it; this immediately changed the solution to a beautiful light golden-colored liquid; after which a solution of arsenious acid was submitted to the same, and the result was precisely similar," etc. Such rough and imperfect processes as these authorized, in the opinion of the examiners, the statement that the chemical analysis "clearly indicated the presence of arsenic." They were equally unfortunate in their deductions from the state of the stomach, which, from the description, appears to have presented that appearance not unusual in an habitually intemperate person, as was the subject of the examination, but which they looked upon also as "clearly indicating that the patient had died in consequence of poison from arsenic."

§ 427. (*a*) *Marsh's process.*—This process for obtaining arsenic from simple or compound mixtures, by which it may be afterwards tried by any or all of the tests above mentioned, is exceedingly delicate. According to Dr. Christison, a solution containing only the millionth part of white oxide of arsenic, will part with it readily in the form of arseniuretted hydrogen, and the slightest trace of that gas in the hydrogen is indicated by this method. The process consists, essentially, in the disengagement of hydrogen gas by the action of sulphuric acid on zinc, in the presence of arsenious acid, the consequent evolution of arseniuretted hydrogen, and the deposition of metallic arsenic upon a porcelain plate held in the flame, resulting from the combustion of the gas.

§ 428. The various modifications of the simple apparatus of

Marsh require no particular description here. The simplest form consists of a wide-mouthed bottle with a closely-fitting cork perforated for two tubes, of which, the one furnished with a funnel dips beneath the liquid, and the other, bent nearly at right angles but sloping slightly towards the bottle, descends but a short distance into the vessel. This tube is furnished with a cork for the reception of a detached horizontal tube of glass, free from lead, and drawn out at its extremity into a point with a small aperture. In this apparatus, hydrogen is generated by pure zinc(*w*) and dilute sulphuric acid, and the action is continued until the atmospheric air is completely expelled, and all risk of an explosion is thereby avoided. The freedom from arsenic of the materials employed, should be ascertained by holding a porcelain plate against the lighted hydrogen gas—nothing but water will be deposited in case the gas is pure. When thus satisfied that the materials are pure, a portion of the suspected liquid may be poured into the funnelled tube, and the spirit lamp be immediately applied to the horizontal tube, in order to obtain a metallic ring or incrustation, which, if arsenious acid is present, will be deposited at the distance of about half an inch from the part to which the flame is applied. Having procured this, the gas, as it issues from the fine end of the tube, should be inflamed, and deposits obtained on porcelain or glass. The two processes may be continued until a metallic deposit is no longer obtained.

§ 429. (*b*) The *fallacies* to which Marsh's process may give rise proceed from the contamination of the zinc or sulphuric acid with arsenic, the presence of antimony in the suspected liquid, or of imperfectly charred organic matter. The mode of guarding against the first has already been noticed. Anti-

(*w*) "Magnesium possesses great advantage over zinc for toxicological purposes. It is now met with in commerce almost absolutely pure. * * * There is one precaution in using magnesium in Marsh's apparatus. Magnesium which contains silicium gives off on contact with acids, siliciuretted hydrogen, leaving a dark-brown deposit. * * * The deposit of silicium left in the red-hot tube is however distinguished from that of arsenic by its disappearance on contact with a drop of nitric acid, whilst the ring and spot of arsenic disappear suddenly when touched with a dilute solution of a hypochlorite. No sample of magnesium ribbon (as it is made for burning) yet tested has given either rings or spots." (Select Methods in Chemical Analysis, W. Crookes. London, 1871, p. 257.)

noniuretted hydrogen burns with a pale, bluish-green flame, and deposits upon a porcelain plate held in it a black stain.

The antimonial is distinguished from the arsenical crust by the following characters:—

First, the dark stain is less bright and metallic than the arsenical one, and when viewed by transmitted light is smoky-black, whereas that of arsenic is hair brown.

Secondly, if the flame be allowed to play on a solution of ammonio-nitrate of silver, placed on the under surface of a plate of mica, no yellow arsenite of silver is obtained.

Thirdly, the greater volatility of arsenic, and its conversion into octahedral crystals of arsenious acid, may serve, where the crust is in an open tube, to distinguish it from antimony. This may be best effected by a bath of olive oil; this liquid does not begin to boil until the heat rises above 600°. Arsenic is completely sublimed under 500°, and the process begins at a much lower temperature; but antimony is not at all affected by the heat required to boil olive oil. Hence, whether the stains of the two metals are mixed or not, their true nature can thus be readily ascertained. Dr. Maclagan says, that in his hands the process has proved "so simple and easy of execution, so delicate in the results obtained by it, so advantageous in excluding the necessity of any chemical reagent whatever," and "also in affording, when tubes of equal size are used, so easy a method of determining approximately the proportion of arsenic in different articles examined, that in operating on small quantities of material, or where little arsenic is present, I have of late always, in practice, adopted it in preference to any other."(*x*)

Fourthly, the comparative solubility of arsenious acid, and the reaction of the before mentioned liquid tests on the solution, will distinguish it from oxide of antimony, which is insoluble.

Fifthly, the metallic crust obtained by submitting a current of the gas to heat, presents some distinguishing characters; the arsenical crust is always deposited in the more distant or anterior part of the tube, whereas the antimonial one is first deposited on the *heated* part of the tube.(*y*)

(*x*) Month. Journ., Jan. 1853. (*y*) Pereira.

Sixthly, arsenical spots on porcelain may also be readily distinguished from those of antimony by the more rapid solution of the former in hypochlorite of soda. They are rapidly dissolved by it, and the porcelain becomes perfectly clean. If they are shining and thick, the process is somewhat longer, but does not occupy more than a few seconds. Antimonial spots, on the contrary, completely resist the action of the hypochlorite of soda, unless they are quite faint and of a dull appearance. Furthermore, if any fluid containing *both* arsenic and antimony be introduced into the apparatus, the spots on the porcelain at first contain principally only arsenic, apparently in consequence of the antimony being less volatile; but if shining spots be produced upon the porcelain, which contain more antimony, these resist, more or less, the action of the hypochlorite of soda, and are often eaten away only around the edges. While, therefore, by this reagent, a slight trace of antimony cannot be distinguished in spots of arsenical nature, arsenic, on the other hand, can by it be detected in antimonial stains.(*z*) The crusts resulting from the presence of imperfectly *charred organic matter* in the suspected liquid are not so readily soluble in nitric acid as are the arsenical crusts, and do not, like the latter when so dissolved, yield a brownish-red precipitate with nitrate of silver.

Seventhly, the following differential test is recommended by Taylor(*a*) as very reliable: "Receive the deposit from the burning gas on the interior of a small white porcelain capsule. Add a few drops of strong nitric acid. The deposit will be immediately dissolved. Evaporate gently to dryness. Moisten the dry residue with one or two drops of water, and then add a few drops of a *strong* solution of nitrate of silver. If the stain was owing to arsenic wholly, or in part, a brick-red colored precipitate will immediately appear. This will be more or less distinct, according to the quantity of arsenic present. The red precipitate (if owing to arsenic) is entirely soluble in ammonia. A deposit of antimony thus treated leaves a white residue (oxide of antimony) insoluble in water.

(*z*) Wackenroder, Chem. Gaz., Aug. 2, 1852. This test was in use by Bunsen in 1844.

(*a*) On Poisons, ed. 1859, p. 394.

ate of silver added to it produces no colored precipitate; if a little ammonia be brought near, either in vapor or d, and a solution of potash be added, a precipitate is ed, which becomes black by standing. Hydrosulphuret mmonia dissolves the antimonial deposit immediately, and evaporation leaves an orange-reddish colored film of sulret of antimony, soluble in hydrochloric acid and insoluble mmonia. The hydrosulphuret does not readily dissolve rsenical deposit, but when gently evaporated, it leaves a t-yellow film (sulphuret of arsenic) not soluble in hydroic acid, but soluble in ammonia. Imponderable quantities e two metals may be thus easily identified. In testing minute films of arsenic, hydrochloric acid must not be with the nitric, since, on evaporation, a portion or the e of the arsenic may be volatilized, and lost as chloride senic."

430. Zinc, sulphuric and hydrochloric acids are often minated by arsenic. The best answer to all objections on the presence of arsenic from accidental sources is, the materials employed in analysis were tested repeatedly e the suspected liquids were introduced into the apparatus.

431. "If, in any case, we have no other evidence to offer that furnished by Marsh's process—a case in which the n must be in infinitesimal quantity, and the metallic deproportionately minute—it would be better to abandon evidence altogether, than to maintain the presence of n from results which admit of no sort of corroboration; ll who have experimented upon the subject, must have ived the utter inefficacy of applying liquid tests to deter- the chemical properties of imponderable and scarcely le sublimates."(*b*)

432. (*c*) *Reinsch's process.*—This method of separating nic is exceedingly simple and efficacious. A solution sup- d to contain arsenic should be acidulated with hydroic acid and heated to the boiling point. A thin leaf of er, or fine copper gauze or wire, bright and clean, should be introduced, and if arsenic exists in the liquid it will

(*b*) Taylor, op. cit., p. 396.

be deposited in an iron-gray film of the metal upon the copper. The copper, being removed after the deposit is formed, must be washed in distilled water, dried, and introduced into a reduction-tube. On the slow application of heat, arsenious acid will be sublimed and deposited on the sides of the tube in the form of minute octahedral crystals. These may be examined by a lens, and then dissolved in water and subjected to the liquid tests. These supplementary tests are requisite, since solutions of various metals give a coating not unlike that of metallic arsenic, and, if the copper is put into the acidulated fluid before it is duly heated, a stain will almost always occur in the presence of organic matters. In proof of the delicacy of this test, Prof. Rainey, of Glasgow, says that "in repeated experiments" he has "found that one-thousandth of a grain of arsenious acid in one million times its weight of fluid, could be separated as a distinct deposit on copper.(*c*) The copper thus coated, when heated gently in a small tube, yielded a slight but distinct sublimate, most obvious on a black ground, and which, with a magnifying power of ten to twenty diameters, was found to consist of crystals with triangular facets, and which when dissolved in water yielded orpiment and the red arseniate of silver when treated with the appropriate reagents." Dr. James St. Clair Gray read a paper to the chemical section of the Glasgow Philosophical Society, "On certain fallacies in the means of detecting some Poisons," in which he pointed out the fact that Reinsch's test for arsenic is liable to fail when the arsenic has undergone oxidation to arsenic acid, or when it exists in the state of sulphuret. He advises the reduction of the arsenic acid by means of sulphite of an alkali; and in the case of the sulphuret he would boil with caustic potash and dialyze.(*d*)

Bloxam's process.—Professor Bloxam has applied the process of electrolysis to the detection of arsenic. The apparatus pro-

(*c*) $\frac{1}{50,000}$ of a grain in the presence of 5,000,000 parts of liquid, yields, after several minutes, a very distinct stain, the outer part of which has a dark, metallic appearance, and the inner, a brownish color. (Wormley, Microchemistry of Poisons, p. 287.)

(*d*) British Med. Journal, March 16, 1872.

l by him consists of a two- or three-ounce bottle, the m of which has been cut off, and replaced by a piece of able parchment, bound on by platinum wire. To the h of the bottle is fitted a cork with a bent tube and a of platinum wire, which passes through the cork, and s up beneath in the form of a hook. A slip of platinum hooks into the end of the wire, and passes nearly to the m of the bottle; it forms the negative pole of the arrange-. The bottle stands in an ordinary test-glass, and the ive pole, also of platinum, stands in the glass. Dilute uric acid is put into the bottle, and also in the glass, so as and at the same height in both vessels. The substance to sted is introduced into the bottle, the cork adjusted, and vires connected by five cells of Grove's battery; the heat spirit lamp is applied to the bent tube, and in the course quarter of an hour a distinct mirror is obtained, if arsenic esent. Standard solutions containing respectively a tenth, ndredth, and a thousandth of a grain of arsenious acid, prepared and examined by this process, and in every case cessful result was obtained.

e solutions were then mixed with organic substances, such e ordinary articles of food—meat, eggs, milk, etc.—and esulting matter examined. This was then dissolved by s of chlorate of potash and hydrochloric acid, and the re- g fluid evaporated down, by means of a water-bath, to a syrupy fluid. The arsenic was thus obtained in a state senic acid, which does not give a certain result by the rolytic process. Some sulphurous acid was therefore d, and the mixture introduced into the bottle, after ex- g the excess of sulphurous acid by evaporation; a drachm cohol was then poured over the surface, and the process nto operation. * * * In all these experiments, of which eat number were made, the thousandth of a grain of ious acid was readily detected.

e other metals which may be detected by this process are ury, antimony, copper, and bismuth; lead is precluded by sulphuric acid which is present. These are all precipitated e metallic form upon a slip of platinum, and even in the

case of antimony a mere trace of antimoniuretted hydrogen is formed, the metal being deposited on the negative pole.(e)

§ 433. (4) *Arsenic in organic mixtures.*—Before the contents of the stomach, the liver, spleen, or the other organs containing arsenic by means of absorption during life, can be submitted either to the process of Reinsch or of Marsh, it is necessary to obtain a solution as free as possible from organic matter. Various means have been recommended for this purpose, those which are the least open to objection are the following:—

If it be intended to separate metallic arsenic by means of Reinsch's process, all the soft solids should be cut into small fragments, distilled water, if necessary, added, and also hydrochloric acid in slight excess. This mixture should be boiled gently for an hour until all soft solids are either dissolved or broken down into fine flakes or grains. Filter through wet muslin, heat the filtered liquid again to the boiling point, and then introduce a slip of copper as before described.

§ 434. If, however, the apparatus of Marsh is to be used, the following process is recommended by MM. Danger and Flandin. Add to the organic matter contained in a porcelain capsule one sixth of its weight of sulphuric acid, and heat until vapors of sulphurous acid appear. The matter is first dissolved, but during the concentration it is charred. The liquor is to be constantly stirred with a glass rod. The carbonization is effected without any swelling or frothing, and is to be continued until the charcoal is friable and almost dry. A small quantity of nitric or of nitro-muriatic acid is to be added by means of a pipette when the capsule is cold. This converts the arsenious acid into the more soluble arsenic acid. The mixture is then to be evaporated to dryness, treated with boiling water, and the limpid liquor introduced into Marsh's apparatus, in which it never froths.

The following excellent process is described by Dr. Will, as being used in the laboratory of Giessen. Before the chemical examination, it is proper to examine carefully the contents of the stomach and intestines, for the purpose of obtaining, if possible, any undissolved portions of arsenic. This is best accomplished by spreading out the mixture in porcelain vessels

(e) Brit. and For. Med.-Chir. Rev., April, 1860, p. 527.

diluting it with distilled water. If the white grains of enious acid should thus be discovered, they should be re-ed on charcoal or tested by means of Marsh's apparatus. however, the arsenic can no longer be separated by me-nical means, the masses of organic matter, *e. g.*, the stomach duodenum with their contents, must be treated in the fol-ing manner:—the liquid contents should be saturated at a tle heat with chlorine gas, and then heated nearly to the ing point to drive off the excess of chlorine, and filtered ough paper free from smalt; the stomach and other viscera uld be cut into small pieces and dissolved by the aid of in as small a quantity as possible of caustic potash,(e^1) then rated with dilute sulphuric acid and the coagulated mass ted with chlorine; or, the mass may be heated in a water- and treated with hydrochloric acid, being stirred all the le, and then gradually small quantities of pure chlorate of sh added, until the liquid becomes thin, and acquires a r yellow color; the heat should now be continued for some e, after which the liquid may be allowed to cool, and then iltered; the undissolved matter upon the filter should be hed with boiling water; the filtered liquid should be con-trated to about a pound; saturate it with hydrosulphuric by the aid of heat; the precipitate of sulphuret of arsenic ich is now obtained, after driving off the excess of sulphu-ted hydrogen, is of a dirty-brown color, owing to the ad-xture of organic matter; this should be washed and dis-lved in caustic potash; this solution may be deprived of its lphur by the oxide of bismuth and heat, and the filtered quid after saturation with dilute sulphuric acid introduced to Marsh's apparatus.

Another and simpler process is that of Reinsch, already escribed. In order to apply it efficiently, the organic matters, fter boiling in hydrochloric acid and water until they are re-luced to a pulp, should be strained. Copper-leaf or gauze is hen to be introduced into the liquid, which, after boiling, is llowed to stand until cool, to permit the deposit of arsenic pon the metallic surface.

(e^1) A blue coloring matter containing arsenic mixed with sulphur, etc., roduced by roasting cobalt ore.

§ 435. We are indebted to Prof. George F. Barker, Professor of Physiological Chemistry and Toxicology at Yale College, for the following testimony which he gave in the case of Horatio N. Sherman, poisoned with arsenic by his wife. As the case has never yet appeared in any work on toxicology, as Mrs. Sherman was convicted mainly by the evidence of the chemical and medical experts, and as we have a copy of the chemical evidence corrected by the professor himself, we make no apology for introducing verbatim in this work the evidence of the chemical expert as given in court.

After certifying to the identity of the stomach which had been committed to his hands by Dr. Pinney, Prof. Barker describes the chemical process by which he assured himself of the presence of arsenic in the viscera from Mr. Sherman's body.

The stomach was ligatured at both orifices; these ligatures I removed. I then opened the stomach by making an incision along the lesser curvature; I emptied the contents into a clean dish and proceeded to wash the inner surface of the stomach with distilled water, for the purpose of ascertaining its condition; I found it to be considerably congested throughout, there being patches showing distinct inflammation, about the cardiac orifice, and at the pylorus. The inner surface was nowhere softened or ulcerated. The contents, which were poured out, consisted of three or four ounces of a dark, offensive, slimy mucus, containing apparently bile. The second package in the box, on taking off the paper, was found to be a roll of new cloth, containing a portion of a human liver. This presented no unusual appearance, being perfectly healthy, with the exception of a small cyst on one side; after making notes of these results, I carried the materials from my laboratory to that of the medical college, and placed the liver in a new, clean glass jar, under double lock and key. I should here mention that in this package was a fragment of a large intestine, the mucous surface of which appeared slightly inflamed. The next day two-thirds of the stomach, and the contents of the stomach, were taken by me from the jar for the purpose of examination. At the conclusion of the examination of these organs, a portion of the liver was likewise examined.

The result of the examination was the finding of arsenic in both these organs. On the third of June, I reported to the grand juror of Derby the presence of arsenic. Subsequently I examined the remaining third of the stomach and a weighed portion of the liver (six and two-third ounces) for the purpose of obtaining the quantity of arsenic present in that organ. The method of analysis followed in all these cases was as follows:—

The portion of the organ to be examined was finely divided, placed in twice its bulk of distilled water, strongly acidulated with pure hydrochloric acid, a few grammes of potassium chlorate were added from time to time, and the whole gently heated. In the course of eight or ten hours the mass was dissolved and a clear yellow liquid was obtained. This was filtered, heated till the odor of chlorine disappeared, and then a washed stream of hydrogen sulphide gas was passed through it for from twelve to sixteen hours. The liquid was again filtered, and the precipitate thus obtained collected upon a filter, washed till free from chlorine, dried on the water-bath, oxidized with pure nitric acid, and then heated with pure sulphuric acid, the heating being continued till the mass was completely charred. Water was then added and a little pure hydrochloric acid, and the whole was gently heated and filtered and the residue washed. Through the filtrate and washings hydrogen sulphide gas was again passed for twelve hours. The precipitate thus produced was filtered off and washed, and upon it was poured upon the filter some pure ammonium hydrate and sulphydrate, previously heated to boiling. The filtrate was received in a porcelain capsule, evaporated to dryness with a gentle heat, and the residue oxidized by repeated evaporations with pure nitric acid; pure sodium carbonate and nitrate were then added, the whole dried carefully and heated to complete fusion. After cooling, the fused mass was dissolved in cold water, the solution filtered, pure sulphuric acid was added, and it was evaporated till the fumes of the acid appeared. To it was then added a saturated solution of sulphurous acid, and it was again evaporated until fumes appeared. It was then diluted with water, and through it was passed washed hydrogen sulphide gas; a heavy yellow precipitate of arsenous.

sulphide was thus obtained. This was filtered off, washed, and dissolved in pure ammonium hydrate poured on the filter. The filtrate was received in a previously weighed porcelain capsule and evaporated to dryness on the water bath; the capsule was then reweighed, and the increase in weight showed the amount of arsenous sulphide which had been added; treated in this way, the six and two-third ounces of liver examined in the second case yielded six hundred and two thousandths of a grain of sulphide of arsenic, which quantity I now produce. (The professor exhibited a small vial containing the article.) This quantity corresponds, by calculation, to four hundred and eighty-five thousandths of a grain of white arsenic, or nearly half a grain. Calling the weight of the liver four pounds, which appears to me to be a fair average—the quantity obtained in two separate and distinct examinations of the same liver being the same relatively to the size taken in the two cases—my opinion is, that this entire liver contained nearly five grains of white arsenic.

Prof. Barker resumed: The sulphide of arsenic produced in the bottle was from a weighed portion of the liver; another portion of sulphide of arsenic was obtained from an unweighed portion; this was oxidized with pure nitric acid by repeated evaporations; the excess of acid was then removed by evaporation with distilled water; the residue was dissolved in distilled water; a small portion was removed and tested with ammonio-silver nitrate; on the addition of this reagent, a brick-red precipitate of silver arsenate was produced. This was inclosed in a small tube, and is contained in the tube herewith produced. [A framed card was here shown, with this tube among others placed on it, with its contents, and marked "silver arsenate."] The rest of the solution was evaporated with a saturated solution of pure sulphurous acid in water, until all odor disappeared; two portions of the liquid thus obtained were removed; one of them, on being tested with ammonio-nitrate of silver, gave a canary-yellow precipitate of silver arsenite, which rapidly became dark olive-brown on exposure to light; this precipitate is here produced, marked "silver arsenite;" the second small portion taken was tested with ammonio-cupric sulphate; a light-green precipitate

of copper arsenite, or Scheele's green, was thus produced; this is here marked "copper arsenite." The remaining portion of the liquid was divided into two equal parts. One of these (A) was evaporated nearly to dryness, mixed with sodium carbonate in excess, and thoroughly dried. The dried mass was then intermixed with a perfectly dried mixture, composed of one part of pure potassium cyanide and three parts of sodium carbonate. Several portions of this mixture were then heated in hard glass tubes, having a bulb blown on one end. Each of these gave a black, lustrous, mirror-like deposit of metallic arsenic. One of these tubes is here produced, marked "metallic arsenic by the reduction test." A second similar tube was prepared, sealed, and the portion containing the arsenic heated; the deposit was readily volatile and condensed in the cooler portions of the tube in a brilliant crystalline sublimate, consisting of distinct octahedral crystals of arsenous oxide or white arsenic. This tube is here produced. [A magnifying glass was produced, and the crystals distinguished by the witness.] Other portions of the dry mass were then tested by heating them in a stream of carbonic gas. (Fresenius and Babo's test.) Each of the portions thus heated gave a bright mirror of metallic arsenic, similar to that obtained in the reduction test. One of these tubes is here produced. No other substance but arsenic gives this test. A second tube was heated, the deposit volatilized, and a ring of crystals of white arsenic obtained as before. The tube containing these crystals, with some of the metal not oxidized, is here produced. The other half (B) of the liquid was divided into two portions; one of these was tested by the method of Reinsch; *i.e.* it was acidulated with hydrochloric acid, and in it strips of copper were boiled. These strips became covered with a steel-gray arsenical coating, which finally became black. One of these strips is here produced, marked "metallic arsenic on copper—Reinsch's test." Another copper strip was heated in a small tube, and afforded a sublimate of white crystals of arsenous oxide, distinctly octahedral by the microscope. These crystals I here produce, marked "arsenous oxide by Reinsch's test."

The second half of this portion was tested by the method

of Marsh; it was added to a flask from which pure hydrogen was being evolved by the action of pure sulphuric acid upon pure zinc; the gas as evolved was freed from acid vapors and from moisture by passing it over solid potassium hydrate and calcium chloride; it was then passed through a long tube of hard glass drawn out at intervals. Before adding the solution the purity of the materials had been tested by heating this tube to redness, and allowing the gas to pass for an hour; no deposit was obtained in the tube. After adding a portion of liquid to be tested, a hair-brown deposit of metallic arsenic appeared in the narrow part of the tube just beyond the heated portion, deepening in color until it finally became black; two of these constricted portions of the tube containing the black deposit of metallic arsenic are here produced, marked "metallic arsenic, in tube, by Marsh's test." At the same time the flame of the burning hydrogen at the end of the tube became bluish-white, and deposited upon a piece of cold porcelain held in it brown mirror-like spots of metallic arsenic; two of these pieces of porcelain containing the spots are here produced. The other deposits in the constricted portions of the tube were then tested; the deposit was found to be readily volatile and oxidizable, giving a ring of crystals of white arsenic; this tube is here produced, marked "arsenous oxide, Marsh's test." Other portions were submitted to the action of hydrogen sulphide gas passed through the tube. On gently heating it, the black deposit of metallic arsenic changed to the bright yellow of arsenous sulphide, or yellow arsenic. Two specimens of the deposits thus obtained are exhibited. The tubes contain a portion of the black metal, and beyond this a portion of the yellow produced from it. The same tests in the same order were applied to the portion of arsenous sulphide obtained from the contents of the stomach, and a series of products obtained in the same way are here exhibited at the top of the card, marked as before, in the same order on the card. During several of these tests, whenever the metallic arsenic vapor escaped into the air, the peculiar odor of garlic was observed. Besides arsenic, I obtained, both from the contents of the stomach and from the liver, sulphide of bismuth; that sul-

phide was converted into subnitrate, and a portion of it from each organ is here exhibited; the tubes are marked "bismuth subnitrate." All these tests throughout were made in duplicate. In order to ascertain whether the materials employed in this investigation were pure, I took, before the second examination of the portions of the body mentioned, a fragment of beef's liver, equal in size to the fragments of human liver previously taken, and examined it in the same way, using the same materials and the same apparatus, except where it was replaced by new articles. No trace of arsenic was obtained in this examination. My opinion, therefore, is, that the material and vessels employed were pure and clean. My opinion, also, is that the yellow precipitate obtained from the weighed portion of the same human liver is also sulphide of arsenic.

To Col. Wooster.—Did not attempt to weigh the arsenic in the stomach as I did in the liver; arsenic, in chemical language, refers to a metal which is black and lustrous, and may be combined with oxygen or sulphur. When combined with oxygen, the form known as oxide is produced; it bears the same relation to arsenic that iron rust does to iron. [Here followed an explanation of the method in which metallic arsenic is obtained, for the enlightenment of the jury.] It is a question whether metallic arsenic is poisonous. It is a general principle that no metal in itself can be poisonous. The sulphide of arsenic and white arsenic are both poisonous, though the white arsenic is more so than the yellow.

Q. Have you any means of telling what quantity of arsenic there was approximately in the stomach you examined?

A. The tissue of the stomach contained no arsenic; the contents of the stomach contained an amount which, though I did not weigh it, I estimated—[Objected to this as a mere guess. Objection overruled, the court holding that the professor ought to know.] It is fair to assume that comparison by bulk is correct. Judging from the bulk obtained from the stomach, the quantity present must have been about one-tenth of a grain.

Q. How long after arsenic is taken does it ordinarily find its way to the liver?

A. White arsenic taken into the stomach is removed there-

from by absorption, and as it has not been detected in either the lymph or the chyle, this absorption must take place by the blood. It has been detected in the urine within one hour after it has been taken. The liver acquires its maximum quantity, in the opinion of several authorities, in from fifteen to eighteen hours after administration.

Q. Does it pass off or remain in the liver?

A. It is eliminated from the liver, and may entirely disappear in from eight to fifteen days after being taken: depending upon the quantity and other circumstances.

Q. What is the maximum quantity the liver of an ordinary adult will contain?

A. I think that the maximum quantity the human liver may contain is the quantity I have found in the present case.

Q. From the presence of this quantity of arsenic, have you an opinion as to how long it must have taken before death?

A. At least fifteen hours; how much longer I cannot say.

Absorption and elimination of arsenic go on together; if there was vomiting and purging, a portion of the arsenic taken Monday night would have been removed before death on Friday. A considerable portion may have been eliminated, during the five days supposed, by the kidneys. Moreover, the arsenic is distributed through the entire body, and the analysis of a single organ or two does not discover the arsenic elsewhere contained. For both these reasons, the amount obtained cannot have been the whole amount taken, and must be less.

Q. Is arsenic a cumulative poison?

A. The question of cumulation depends upon the definition of the word cumulative. If by cumulative is meant the accumulation of a substance in the body when it is taken more rapidly than it can be eliminated, then arsenic or apple-pie may be regarded as cumulative. If by cumulative be meant a substance which enters into combination directly with certain tissues, so as to form a compound less readily removed than the original substance taken, or not removed at all, then arsenic in my opinion is not a cumulative poison. I have heard the testimony of Dr. Beardsley in relation to the sickness of this man; the quantity of arsenic found in his stomach may have been, in my opinion, either the last traces of a very large quantity

en on Monday night, or the residue of a smaller quantity
en subsequently; which I cannot tell, but the latter appears
ne the more probable. The first effect of arsenic when
inistered is local. It is specified as an irritant, but not a
sive poison—that is it inflames the parts it comes in con-
with, without destroying, softening, or perforating them;
ocal effects thus first produced cause local symptoms;
appear generally in an hour after the poison has been
owed. They are burning pain in the stomach which, as
oison passes down, extends along the intestinal tract. It
ases in severity, is accompanied by great thirst, dryness
constriction of the throat, vomiting and purging. The
ers vomited are dark, bilious, and offensive. By this time
e or less of the poison has become absorbed; it enters the
d and produces a second class of symptoms called remote,
action being apparently mainly upon the blood corpuscles;
se symptoms are characterized by great prostration of
ength, anxiety and depression of mind, a peculiar lividity
the face, a blue line under the eyes, the intellect being as
et unaffected, and the mind clear; death may ensue at this
tage of the action, due to the prostration; usually taking place
nder these circumstances, in from one to eight days; if life
e continued, the effect of the arsenic is apparent upon the
ervous system and brain; stupor, passing into profound coma,
ay develop itself in case the action is primarily upon the
ain; delirium and convulsions, passing into tonic spasms,
case the spinal cord is also involved, may precede death;
of these symptoms may not be present in any one individu-
; the patient may recover from all these symptoms, which
ay be called primary, and may die from the secondary effects
the poison years afterwards; white arsenic, when taken into
e stomach, is dissolved both in the stomach and intestines by
e gastric and intestinal juices; spread out upon the posterior
rface of these intestines, is a set of bloodvessels which com-
se what is known as the portal system; the arsenic thus
ssolved passes into these bloodvessels through their walls;
ese vessels unite, thus forming the large trunk known as the
rtal vein, which empties itself directly into the liver, so that
is organ is not only more fully supplied with blood than any

other, but it is supplied with blood charged with arsenic from the intestines; hence the liver is more likely to contain this poison than any other organ. It passes from the liver into the general circulation, and thus produces its remote effects. Most probably it does its fatal work on the blood itself, disintegrating the blood-corpuscles, thus rendering the blood unfit to perform its functions. From two and a half to three grains of arsenic would kill an adult; less quantities than that have been fatal; and more has been taken without producing death. Arsenic would not probably be found if death ensued from the secondary effects. Persons have died from the primary effects of arsenic in eight days, and no trace of the poison has been found in the body on analysis. Constriction of the throat, when arsenic is taken, occurs from one-half hour to an hour ordinarily.

Q. Assuming that the liver you examined was Horatio N. Sherman's, of what do you think he died?

[Objected to, and admitted as the witness's opinion, based on his own analysis.]

A. My opinion is, that, considering the symptoms as described and the presence of arsenic as stated, Horatio N. Sherman died from the effects of a poisonous dose of arsenic.

I found in a locked drawer, upon my return from New York in July, a package, which I now produce; a white paper, tied with a red string, with the word "bismuth" written on it, which I found to contain sub-nitrate of bismuth upon opening it. Forty grains of it were examined for arsenic, with a negative result. The bismuth was pure.

The white crystals of white arsenic not appearing distinctly in the tubes on the card, I have placed beneath them black paper to make them distinctly visible. I did not mention the effect of the poison on the action of the heart and lungs; the pulse during great prostration is generally small and rapid; sometimes, when the prostration is great, the pulse is less rapid than usual; the respiration is difficult, requiring almost a voluntary effort to breathe; it is sometimes quick and sometimes slow; the action of the poison on the lower intestines is to produce tenesmus, *i.e.*, straining without result; inflammatory action produces a dry and hot skin at the first stages;

after collapse the skin is cold and clammy, and sometimes moist; the inflammation causes dryness and a folding up of the mucous membrane; there is also more or less faintness; sometimes entire syncope; purging may be wanting; convulsions are exceptional; the same is true of delirium.

Cross-examined by Mr. Watrous: I commenced the analysis on the 6th of November, 1871, and obtained the sulphide on the 23d of the same month; took the 6¾ ounces from a portion of the liver left at my office; first received it on May 13th; from that time until November 6th it was in my laboratory, hidden behind some other bottles, in a sealed glass jar, in a cupboard which was locked; the laboratory was locked; only myself and the janitor had keys; was not in the laboratory daily; have no recollection of any one being present while I was there; opened the bottle only once from May 13th to the 30th of June; it was not labelled; no one was present when I opened it; opened it in the daytime; gave the janitor instructions in regard to it; did not point it out to him; I pointed to the door, and said that that was not to be opened by him or any one else by his knowledge; told him I had an important investigation in progress, and it musn't be interfered with; didn't tell him what I was looking for; was looking for poison —not for arsenic. I was told that arsenic was suspected; was not requested to examine it in order to see if arsenic was there; looked for all metallic poisons; could have discovered antimony as readily as I did arsenic; was not told there was a suspicion of anything but arsenic; did not start in my investigation with that in view. Never made any experiment with the view of finding arsenic.

[The witness here appealed to the court to make an explanation, in reply to questions asked him; and the court held that the professor had a right to make any explanation to make his answers clear.]

Q. If you did not find arsenic either designedly or by accident, how did you find it?

A. I was looking for metallic poisons, and found arsenic. [The witness was going on to make an explanation, when Mr. Watrous objected, but finally withdrew his objection.]

The explanation: The examination is for metallic poisons, and not for one or two or three, but all. And if one is found, it is found without especially looking for it. If arsenic had been there alone, some other process than the one I followed might have been better. I looked at the jar occasionally to see that it had not been disturbed; don't know how many kinds of chemicals I mixed with the human liver during my analysis; think it was not fifty, nor twenty-five, nor fifteen; possibly ten; cannot tell exactly, without counting.

[Mr. Watrous asked witness to count them up.]

Witness: If I have counted correctly, I used ten chemicals in the analysis; no means of getting at the bulk of the chemicals used. The following is a list of chemicals I used in the analysis: Water, hydrochloric acid, potassium chlorate, hydrogen sulphide, nitric acid, sulphuric acid, ammonia, ammonium sulphydrate, sodium nitrate, sodium carbonate, and sulphurous acid. Tested the sulphuric acid and found it pure; sulphuric acid does sometimes contain arsenic; this is not true of sulphurous acid. I used half a fluidounce, about four hundred grains of sulphuric acid during the tests; know what I obtained was sulphide of arsenic.

It is not settled among chemists whether arsenic is a metal; it is not absolutely known that it is not itself a compound; the elements of it, if it is a compound, are of course not known; know that the process through which I put the liver would not produce arsenic; I have gone through the same process many times, and never generated arsenic; I know as well as I know anything, that arsenic was not generated in this case; I believe it as much as I believe I exist; I cannot prove that I exist; it is not claimed that chemists can manufacture diamonds or things that cannot be told from diamonds; have heard of the Wharton trial; have read the testimony of chemists claiming to be such, whose testimony differed as to the existence of antimony; the main difference was whether it was enough to cause death, not about the existence of it; arsenic in bismuth is very uncommon now; it is found sometimes with bismuth; if bismuth in which arsenic was put had been placed in the stomach, I should have found them separately; bismuth

is not a poison; it would not kill a man if taken into his stomach; subnitrate of bismuth won't kill.(*e*²) * * * *

§ 436. It is hardly necessary to state that whatever process is preferred, the previous examination of all the chemical reagents is necessary to provide against the accidental presence of arsenic. The necessity of these precautions is obvious, but the means of providing against them are equally so.

(5) It was at one time supposed, upon the authority of Orfila, that arsenic was *a natural constituent of the human body;* but his own admission of his error, and repeated subsequent trials, have proved that this is not the case,(*f*) that it exists neither in the bones nor in the soft parts. It has been found in the soil of cemeteries, but in an insoluble form, being separable only by concentrated sulphuric acid; the objection, therefore, that, if detected in the body, it may have been derived from this source, is not applicable, unless the coffin has been broken, and the soil become mingled with those portions of the body subjected to analysis. In this case a portion of the soil taken from the adjacent earth may be examined, for the purpose of ascertaining whether the arsenic is really derived from it. Where the coffin has been entirely disintegrated, and the earth is thus indistinguishable from the human remains contained in it, a chemical analysis can hardly be demanded. But when, on the contrary, the body is in a tolerable state of preservation, and the earth has gained access to it only through crevices in the coffin, without coming in contact with the stomach and other viscera, it is evidently an unwarranted and fanciful idea to attribute the origin of arsenic found therein to the minute trace which may possibly exist in the surrounding soil.(*g*)

(*e*) Mrs. Sherman was convicted on the testimony presented, and has, since her conviction, confessed not only to her guilt in this case, but also to the murder of her former husband and of six children.

(*f*) *Vide* Lehmann's Physiol. Chemistry, vol. i. p. 449. Translated by George R. Day.

(*g*) Walchner has discovered arsenic in many ferruginous earths, and in the deposits of certain mineral springs. Will and Scherer and others have made the same observations. Becker examined the soil of a churchyard, and found that every part of it contained arsenic. (Canstatt's Jahresbericht, 1846, 1847. Bd. v.)

Nevertheless, in the following case a competent chemist thought that there was good reason for supposing that arsenic must have been administered. A verdict of wilful murder having been returned by a coroner's jury against a woman named Rebecca Smith, for causing the death of her infant child by poison, the bodies of two of her other children, who had also died in infancy, were disinterred and sent to Mr. Herapath, of Bristol, for examination. The soft parts of the bodies were entirely gone, and the bones were all separated from each other. The coffins were decomposed and penetrated in all directions by the roots of a tree. The roots of trees as large as the little finger had passed through the head and skeleton, and had followed the bones in all directions. He found arsenic in the bones, in the black mould under the head, and a greater quantity in the black mould under the ribs. One of the bodies had been interred five and the other eight years. In his testimony before the coroner, Mr. Herapath said: "I have never found arsenic in a body which was in its natural state." * * * "I have made experiments on hundreds of bodies of human beings and brutes, but have never discovered arsenic unless it had been administered medicinally or for a criminal purpose. I have also made experiments upon soils, and I believe the statement of Orfila to be a mistaken one. My opinion is, that arsenic was administered to both these children during life, and that it was the cause of death; it existed in too great quantity to have been administered for a medicinal purpose." The jury without hesitation returned a verdict, "That the deceased children died from the effects of arsenic, but how or by whom administered there is no evidence to show."(*h*) In the absence, however, of any statement of the process by which the arsenic was obtained from the bones and the mould, this case cannot be considered of great importance.

§ 437. The experiments of Orfila, in 1839, have since been confirmed by numerous observations, and the fact is well established that arsenic in the combination in which it exists in the soil is completely *insoluble*, and consequently cannot be

(*h*) Lancet, 1849, p. 253, Am. ed.

carried by the percolation of rain into the organs of the body. Boiling water does not dissolve the slightest trace of it, and it is only by the prolonged action of boiling sulphuric acid that it can be separated from the earth containing it. In illustration of these remarks we append the following: In 1844, Nicolas Noble and a woman named Jerome, both of whom died with the symptoms of poisoning, were buried in the cemetery of Epinal, the earth of which contains arsenic. Their graves were two yards apart. The bodies were ordered to be disinterred; in the woman there was not found the slightest trace of arsenic, but it was discovered in the stomach and intestines of Nicolas. Six months later the bodies were again exhumed; the *result was the same*, although the body of the woman had been, after the first examination, immediately replaced in the grave without any coffin, and covered with the soil which had been thoroughly soaked by an abundant rain. There were reunited here all the conditions of putrefaction and moisture supposed by some to be most favorable for the formation of an arsenite or arseniate of ammonia and the imbibition of the body by it; nevertheless the soil treated with boiling water did not give up a trace of any arsenical salt, and no arsenic was found in the woman's body. In that of the man, on the contrary, it was found in the liver, after it had been carefully washed. The correctness of the inferences from the chemical analysis was soon fully established by the confession of the criminal.

Another case, occurring in the year 1851, in France, is not less remarkable. On that occasion, M. Barse, a distinguished chemist, gave the following opinion when called upon by the government. "Arsenic exists in the soil only in an insoluble state; hence it cannot be communicated by means of infiltration to the bodies contained in such soils; and, therefore, if arsenic is found in such bodies, it must have been derived from other sources." He examined other bodies contained in the same cemetery, and found that in none of them was there a trace of arsenic, although it existed in the soil.(*i*)

(*i*) *Vide* Briand, Méd. Lég., p. 520.

III. *Suboxide of Arsenic.* (Fly Powder.)

§ 438. This substance, which is often sold under the name of kobbolt, has been the source of many cases of accidental poisoning upon the continent of Europe. The symptoms and effects are precisely similar to those of arsenious acid. In this and other countries, paper soaked in a sweetened solution of this or some equivalent compound of arsenic is used for destroying flies.

IV. *Arsenic Acid.*

§ 439. *Arsenic acid* is seldom met with out of the chemical laboratory; it has been proved by experiments upon animals to be poisonous, and may be recognized by the brownish-red precipitate it gives with nitrate of silver, its solubility in water, and in yielding a metallic crust or deposit, by the apparatus of Marsh or Reinsch.

V. *Arseniate of Potash.*

§ 439*a*. Dr. Christison is the only author who refers to cases of poisoning by this article. He quotes two cases of accidental poisoning by it.

VI. *Arseniate of Soda.*

§ 440. The only instances reported of poisoning by this preparation are quite recent. Two young men sent to a chemist for doses of tartrate of soda, in place of which the arseniate of soda was sent by mistake and taken. In about five minutes they were attacked with violent cramps in the stomach, which speedily became very intense. One died in consequence, and the other remained in a dangerous state.(*j*)

VII. *Sulphurets of Arsenic.*

§ 441. There are several of these compounds known in commerce as *realgar* of an orange-red color, orpiment which is yellow, and (it is said) another preparation, bearing the same

(*j*) Am. Journ. Med. Sci., Oct. 1852, p. 553, from the Journ. de Méd. and Chirurgie, June, 1852.

name, which is a compound of pure sulphuret and arsenious acid. The pigment known as King's yellow contains a sulphuret of arsenic and a considerable proportion of lime and sulphurets. Cases of intentional and accidental poisoning with orpiment are known. A female was poisoned with it in England in 1835, and the poison found in considerable quantity in the stomach of the deceased fourteen months after death. Its character was satisfactorily proved by chemical analysis, and led to the apprehension and conviction of the murderess, who was afterwards executed.(*k*) Another case, in which it was mixed in porridge, in mistake for turmeric, is related by Dr. Jochner. An old man and his nephew both partook of the food without immediately discovering the mistake. The prominent symptoms were continual vomiting, burning pain in the stomach, and gradual collapse. The old man died in twenty-two hours; the boy escaped. Evidence of violent inflammation was found in the œsophagus and stomach, the mucous coat of the latter being soft and thickened. There was a sphacelated spot, one inch in diameter, in the œsophagus, and another in the stomach of three inches in extent.(*l*)

The sulphurets of arsenic may be analyzed either by the sublimation of metallic arsenic from them in the reduction-tube with an appropriate flux, or by testing with Reinsch's or Marsh's apparatus.

They also yield arsenic when boiled with hydrochloric acid and copper. Orpiment is soluble in a solution of caustic potash, but insoluble in hydrochloric acid. From the fact that orpiment is insoluble in water it can often be separated from an organic mixture by drying the mixture upon bibulous paper; otherwise, the mixture should be dried and boiled with nitric acid to dryness until the organic matter is destroyed. Any sulphuret will then be found decomposed, in the form of arsenic acid, soluble in water. They may be separated from *organic mixtures*, by adding caustic ammonia to dissolve them, and then precipitating them by hydrochloric acid, or they

(*k*) See the case quoted in Beck, vol. ii. p. 560.
(*l*) Henke's Zeitsch. Erg. H. 43, p. 162.

may be separated mechanically by mere subsidence, filtration, and drying.

VIII. *Arsenuretted Hydrogen.*

§ 442. This gas is colorless, has the smell of garlic, and is exceedingly poisonous. Several cases are related in which chemists, in experimenting with it, have perished in consequence of accidentally inhaling it. The symptoms were similar to those usually seen in poisoning with arsenious acid, viz., giddiness, vomiting, pain in the stomach, and collapse. In the case related by Dr. O'Reilly, death ensued on the sixth day, and Gehlen, the German chemist, died in nine days.(*m*)

The gas inhaled was, in the first of these cases, supposed to be pure hydrogen, but was contaminated with arsenic, owing to the impurity of the sulphuric acid used in generating it. The mode of obtaining it and of testing its properties has been already described.

IX. *Arsenite of Potash.*

§ 443. These and other compounds of arsenious acid with alkaline bases are poisonous. The solution of arsenite of potash is of much use in medicine, especially in the treatment of chronic skin diseases and intermittent fever. It receives its taste and color from the spirit of lavender, as officinally prepared, and contains four grains of arsenious acid to the fluid-ounce, the usual dose of which is, for an adult, ten drops, three times a day. From the occasional adulteration of arsenic with the sulphate of lime, this preparation is no doubt sometimes weaker than the officinal strength. Two cases of fatal poisoning by it have been before referred to. In one of them the dose did not amount to more than two grains in five days. In the other the amount swallowed was not ascertained. The symptoms are the same as those produced by arsenious acid. The dose, however, which will produce poisonous effects is very uncertain. This liquid may be tested, after acidulation with hydrochloric acid, by means of hydrosulphuric acid, which

(*m*) Dublin Journ., vol. xx. p. 422; Buchner's Toxicologie, p. 476.

precipitate a brownish-yellow sulphuret, or it may be
l by Reinsch's method and the liquid tests.

X. *Arsenite of Copper.* (Scheele's Green.)

44. As this article owes its poisonous properties rather
arsenic contained in it than to the oxide of copper, we
anged it with the arsenical compounds. It has frequently
ned accidents in England and on the continent from its
a coloring ingredient in confectionery. In 1850, Dr.
y reported three cases of poisoning by Scheele's green,
came under his notice; and he states that between
and forty children were poisoned at the same time by
neats sold to them by a confectioner in Petticoat Lane.
ated, moreover, that as many as seventy cases of poison-
ad been traced to a similar source within three years.(*n*)
hild was given a green card to play with, and soon after-
s was seized with the symptoms of arsenical poisoning.
s found that the glazing of the card, which contained
was colored with Scheele's green.(*o*)

e symptoms produced in the cases reported have been
nt colic, vomiting, and diarrhœa, intense thirst, and re-
ion of the abdominal parietes. In some cases juandice
ccurred.

nanations from walls painted with this green color, or hung
paper stained with it, are capable of producing unpleasant
toms.

ce the first edition of this work a very large number of
of poisoning in this manner have been reported. The
common symptoms produced are headache, great depres-
faintness, dryness of the throat, nausea, vomiting, and
minal pain. Even paralysis has been occasioned. Accord-
o Dr. Taylor, a square foot of paper hangings stained with
ceto-arsenite of copper may yield from twenty-eight to
ty grains of the arsenical pigment.(*p*) The last case re-

Brit. and For. Med.-Chir. Rev., July, 1851.
Bost. Med. and Surg. Journ., vol. xxxvii. p. 107.
The reader desirous of investigating this subject may consult the fol-
articles: Times & Gaz., Feb. 1857, p. 177; Ibid., May, 1857, p. 520;

ferred to in the note is that of a watchmaker, who became affected with ulceration of the mouth and salivation in consequence of his using a shade painted green to cover the gaslight by which he worked.

There is no doubt in the minds of the best physicians of the present day, that arsenical papers do produce in some persons (perhaps being predisposed to its influence) arsenical poisoning, sometimes to such a degree as even to threaten life itself. Dr. Taylor, in his last edition (p. 845), and in the *Med. Times and Gazette* (London, Jan. 1st, 1859), states that he "examined some fine *dust* on some books in a book-case secured with glass doors, and found therein a well-marked quantity of arsenic." In the house of a friend in which arsenical paper was hung, he found arsenic in the dust on the cornices, and on the gold mouldings of the picture frames. The Massachusetts Board of Health(*q*) deemed this subject of sufficient value to cause some investigations to be made by Dr. Draper, of Boston, on the subject of paper hangings, confectionery, pastry ornaments, toys, artificial flowers, and other articles of dress being colored by pigments containing poisonous preparations of arsenic.

§ 445. The process for obtaining this salt from organic mixtures is the following, as described by Dr. Christison. The arsenite should be dissolved by heating the mixture with a little hydrochloric acid, and then stirring it. After being allowed to cool, it should be filtered. A stream of hydrosulphuric acid gas will now cause a dark-brown muddiness or precipitate, which is a mixture of sulphuret of copper and sulphuret of arsenic. The precipitate being separated after boiling, and properly cleansed by the process of subsidence and affusion, or if it is large, by washing on a filter, the two sulphurets are to be separated by ammonia, which dissolves sulphuret of arsenic, but leaves the sulphuret of copper; and the sulphuret of arsenic may be recovered from the filtered fluid by expelling the ammonia with heat. Being thus sepa-

Ibid., Jan. 1858, pp. 64, 76; Jan. 1859, pp. 5, 43, 94, 169; Brit. and For. Med.-Chir. Rev., April, 1859, p. 519; Lancet, July, 1859, p. 95; Jan. 1860, p. 85.

(*q*) Report, January, 1872.

rated, each salt may be tried by the appropriate tests enumerated under the heads respectively of *Arsenic* and *Copper*.

XI. *Corrosive Sublimate.* (Bichloride of Mercury.)

§ 446. The corrosive chloride of mercury is white and crystalline in appearance, and has an exceedingly acrid, styptic, metallic, and durable taste. It dissolves in about ten parts of cold water, and in three of boiling water. It is soluble also in alcohol and ether. (*Wood and Bache.*) The very poisonous nature of this substance is familiar to every one. It is seldom if ever taken in large doses, except by mistake, or with suicidal intentions.

§ 447. 1st. The *symptoms* which it produces are of the most urgent and alarming character, and generally supervene very soon after it is swallowed. At the moment of being swallowed there is usually an involuntary constriction of the throat, which has in many cases prevented the whole of the draught from being taken. Vomiting of a bloody and frothy liquid soon occurs, and continues throughout the case, attended with violent purging, but the latter symptom is sometimes absent. There is excessive pain in the abdomen, not always increased upon pressure, and also burning and smarting in the throat. The general symptoms are at first those of febrile excitement, with great thirst, and are followed by exhaustion and collapse, a cold and clammy skin, small and frequent pulse, and difficult respiration. In most cases the urine is either entirely suppressed, or very scanty and difficult to void.

The duration of the case is very variable, sometimes terminating in a few hours, and in others being prolonged beyond a week. In a case reported by Dr. Coale, death took place on the eleventh day; and in another, by Dr. Jackson, on the thirteenth day.(*r*) Death may not occur until later, from the consecutive effects. Such was the case in an instance reported by Dr. Ware, where the patient died of dysentery on the fifteenth day.(*s*)

2d. The *smallest quantity* capable of destroying life is not ascertained with precision; children have been killed by three

(*r*) Am. Journ. Med. Sci., Jan. 1851. (*s*) Ibid.

grains; and Dr. Taylor considers that the average fatal dose may not differ widely from that of arsenic, *i. e.* two or three grains.

In Dr. Coale's case less than ten grains were swallowed. Dr. Frisselle reports a case which is remarkable for the indifference to the symptoms upon the part of the patient. A woman took a drachm of corrosive sublimate in solution. She was immediately seized with a burning sensation in the throat, and copious vomiting of a dark, frothy substance, which was followed in about an hour by purging, which continued till the next day. She still, however, attended to her domestic duties, and no remedies were given internally until thirty-six hours afterwards. She died on the sixth day, with vomiting of a dark grumous matter.(*t*)

"Persons have been known to recover who have taken very large doses when remedies have been timely administered, or when there was early vomiting. * * * A case of recovery after forty grains had been taken in whiskey, under circumstances favorable to its fatal operation, *i.e.* on an empty stomach, is recorded by Dr. Andrews (in Cormack's *Journal*, Feb. 1845, 102)."(*u*) Poisoning by this agent is oftentimes extremely slow, and sometimes is not manifested for several months after exposure to mercurial vapors. Long before this period the face becomes swollen, the complexion livid, all the functions languish, ending in hemorrhages from the mucous surfaces, and from time to time the patients are afflicted with diarrhœa. The theory of the action of this poison has been explained by Dr. G. Sée.(*v*) As soon as the mercury is received into the blood, it is combined directly with the albumen of the *plasma* and the proteine of the corpuscles; this is the cause of mercurial anæmia. The white corpuscles, however, maintain their normal condition.

The antidote to mercurial poisoning is albumen in a large amount of water (too much of the antidote causes a *re*-solution of mercury). The albumen is precipitated into a solid form by the mercury, and this can then be ejected from the stomach.

(*t*) Boston Med. and Surg. Journal, 1850, p. 279.

(*u*) Taylor, ed. of 1859, p. 461.

(*v*) Leçon de Pathologie Experimentale, 1er fascicule. Paris, 1866, p. 275.

§ 448. The form under which mercury or corrosive sublimate is administered, either with homicidal or suicidal intent, is in that of an aqueous or alcoholic solution. In all cases its action is locally irritant, and general intoxication follows from its absorption into the blood. It is therefore necessary to distinguish the acute from chronic poisoning.

§ 449. 3d. *Post-mortem appearances.*—In the case mentioned by Dr. Frisselle, no appreciable lesion was discovered. In one reported by Dr. Williams,(*w*) the stomach which was contracted in the shape of a dumb-bell, presented patches of dotted injection, of a bright crimson tint. There was no ulceration nor ecchymosis, but the mucous membrane was a little softened in the neighborhood of the most vivid red patches. Similar patches were seen throughout the small intestine. The bladder was contracted, and contained about a drachm of turbid urine. The other organs were healthy. The dose in this case was thirty grains, and the patient lived two days. In an instance reported by Dr. Herepath, the stomach seemed to have escaped the action of the poison, but the cæcum was of a deep black-red color, and portions of it were in a sphacelated condition.(*x*) The mucous membrane of the mouth and fauces usually exhibits traces of the action of this corrosive poison, being changed to an ashy blue color; but in the first two cases here noted, and the following one, in which a drachm was taken, the mucous membrane of the mouth and œsophagus was perfectly healthy. The principal effects of the poison were observed in the stomach, its mucous and muscular tissues, commencing at the cardia, to the extent of three inches and a half and about the same in breadth, were converted into a gangrenous mass, having a corroded, ragged appearance, of a dusky-brown color, approaching to black. The mucous coat, to some extent, around this gangrenous portion, was of a brownish-red, but the lining membrane of the pyloric half of the stomach, except a few slightly red patches, was quite healthy. The bladder contained only half an

(*w*) Boston Med. and Surg. Journal, 1850, p. 279.
(*x*) Lancet, Dec. 1845.

ounce of urine, although none had been passed for twenty-four hours before death. The lungs were extremely congested.(y)

Other cases are mentioned, similar to those of Drs. Coale and Williams, in which, although the quantity taken has been large, and the signs of suffering in the stomach and the general symptoms presented the most violent character, the traces of a corrosive poison have been comparatively insignificant.(z) The period of survivance seems to make little difference in the aspect of the alterations found post-mortem. Dr. Coale's patient lived eleven days, and the two reported by Taylor between four and five days.

Most ordinarily the change in the intestinal canal occurs as ecchymotic spots, accompanied by sanguineous effusions. The kidneys present a lively injection of the renal parenchyma, especially near the Malpighian bodies; the epithelial cells are deformed, granular, and partially destroyed, obstructing the *canaliculi*. This granular condition is analogous to that described under the head of phosphorus, and has been especially noticed in poisoning by the strong acids, ammonia and arsenic. The blood is ordinarily black and fluid. The alteration in the kidneys above described would harmonize with the albuminuria which occurs in poisoning by mercury. It is rather remarkable that in cases of poisoning from the external application of mercury precisely the same traces of inflammation, ulceration, and gangrenous patches are observed as in those cases from its internal administration. There is a case reported by Vidal(a) of the poisoning of a woman by the accidental application of the acid nitrate of mercury, instead of a liniment, to the cutaneous surface of the whole body. The internal surface of the stomach was red, the vessels were injected, and there were ecchymotic spots. The same ecchymoses were observed under the mucous surface of the bladder, and in the whole length of the intestines. The blood was black and fluid. In the microscopial examination the renal parenchyma was found very much injected, especially in the

(y) Wade, Lancet, June, 1848, p. 498.

(z) *Vide* Taylor on Poisons, and a case by Dr. Hodges, Am. Journ., Jan. 1855.

(a) Gazette des Hôpitaux, Juillet, 1864.

vicinity of the Malpighian bodies; the epithelial cells were deformed, granular, and partially destroyed. M. Flandin, by chemical analysis, had recovered a sensible quantity of mercury from the tissue of the liver; the other organs showed no traces of the poison.

§ 450. A few other cases of death from the *external application* of corrosive sublimate are on record. In one the subject was a child, and the severest constitutional effects were produced. It died in about a week.(*b*) In two others, also children, of seven and eleven years respectively, an ointment composed of two drachms of corrosive sublimate to an ounce of tallow was rubbed into the scalp. The children were affected with *porrigo favosa*. Excessive suffering was the almost immediate consequence, and in forty minutes they were completely delirious. They vomited continually a green-colored matter, had great pain in the bowels, with diarrhœa and bloody stools. In the youngest there was complete suppression of urine. Death occurred in one on the seventh, in the other on the ninth day. There was no *ptyalism*.(*c*) In a case in which from fifteen to twenty grains of corrosive sublimate were injected into the vagina, there occurred, besides local symptoms, vomiting, bloody purging, coldness of the extremities, spasms of the fingers and toes, and salivation. Recovery took place.(*d*)

§ 451. "The symptoms of mercurial poisoning are of incontestable value as evidence, and more so, perhaps, than for any other poison of the hyposthenizants; the clinical record has here a certain signification, and allows of an almost certain diagnosis.(*e*) There is no disease which in the acute form has such a fatal result, consequent upon the specific buccal lesions; and for the chronic form, the cachexia, which constitutes the common ground of so many diseases, imprints in this case a particular character to such nervous phenomena as the tremblings, partial paralyses, and pains in the bones. Syphilis alone can be confounded with chronic mercurial poisoning."(*f*)

(*b*) Am. Journ. Med. Sci., July, 1844, p. 259.
(*c*) De Ricci, Dub. Quart. Journal, Aug. 1854.
(*d*) Butcher, Dub. Quart. Journal, Feb. 1856, p. 242.
(*e*) Tardieu, op. cit., p. 571. (*f*) Ibid.

§ 452. There may be some reason for confounding mercurial poisoning with that of arsenic. But the taste of these two poisons is different; that of mercurial preparations is much more pronounced and has not the sweetish, followed by the bitter taste which has been mentioned in arsenic. The appearance of the first effects of the corrosive sublimate is instantaneous, whilst that of arsenical poisoning may be delayed an hour or more. The lesions of the mouth and œsophagus are wanting in arsenical poisoning, whereas they are almost specific signs of mercurial poisoning, as are the fetor of the breath and the loosening of the teeth.

§ 453. Poisoning by copper is in some respects analogous to that of mercury, but a close attention to the signs of copper poisoning, which will be discussed further on, as well as the comparatively less violent mode of action of the former, will serve to distinguish these poisonings.

§ 454. We take the following lucid exposition of the chemical analysis for corrosive sublimate from Dr. Guy's work on *Medical Jurisprudence.*

4th. "*Tests.*—We may have to examine the poison in the solid form, in solution, and in organic liquids.

(1) "*Corrosive sublimate in the solid form.*—On the supposition that we are ignorant of the nature of the substance submitted to analysis, we first heat a small quantity on platinum foil. It is completely volatilized. It may therefore be arsenic, corrosive sublimate, or calomel. The great solubility of corrosive sublimate in water distinguishes it at once from the other two substances. The addition of a few drops of liquor potassæ places the nature of the substance beyond a doubt. Corrosive sublimate is changed to a yellow color, while arsenic undergoes no change, and calomel is turned black. We may obtain still further assurance by the following tests: 1. Hydrosulphuret of ammonia changes the powder to a black color. 2. A solution of iodide of potassium turns it to a bright scarlet. 3. Moisten a clean rag with dilute muriatic acid (one part of the acid to two of water), sprinkle upon it a small quantity of the powder, and rub it on a clean plate of copper. A silvery stain is formed, which is readily volatilized by heat. 4. Mix one part of the poison with three or four parts of calcined

carbonate of soda; place the mixture in a reduction tube and apply the heat of a spirit lamp, having previously dried the upper part of the tube. A ring of globules will be formed on the cool sides of the tube.

§ 455. (2) "*Corrosive sublimate in solution in water. Sulphuretted hydrogen.*—On the supposition that we are ignorant of the contents of a liquid submitted to analysis, we test for a base by sulphuretted hydrogen. Corrosive sublimate is one of those which yields a black precipitate, first giving a milk-white appearance to the liquid. With liquor ammoniæ it gives, in common with lead and bismuth, a white precipitate, but with liquor potassæ, a yellow (the hydrated peroxide). By this we recognize a per-salt of mercury. The supernatant liquor contains chloride of potassium, and, if we add to it nitrate of silver, we obtain the white chloride of silver, which proves that the salt of mercury is a chloride. This precipitate, being collected, washed, and dried, and heated in a reduction tube, gives a well-defined ring of mercury." By using the other precipitates in the same way, a similar result will be procured. The following are additional tests.

(*a*) "*Protochloride of tin.*—A solution of this substance throws down a white precipitate, turning rapidly to gray, and from gray to black. This consists of minutely divided mercury, from which the supernatant liquor may be decanted, or separated by filtration. On introducing into the tube containing this precipitate a plug of blotting-paper, and pressing it firmly against the bottom of the tube, the globules are made to coalesce, so as to form a mirror of mercury.

(*b*) "*Metallic test.*—Acidulate the liquid with a few drops of muriatic acid, and introduce a narrow slip of clean copper. A gray film will be formed on the surface of the metal. This, being carefully dried, may be introduced into a reduction-tube, and heated with the flame of a spirit-lamp. A ring of metallic globules will be deposited on the upper part of the tube. Pure tin, zinc, or silver, may be substituted for copper. The latter is to be preferred to any other metal.

(*c*) "*Galvanic test.*—Take a narrow strip of sheet zinc of a size convenient for introduction into a reduction-tube; moisten it, and take up as much gold leaf as will adhere to it. In-

troduce this into the solution, slightly acidulated with muriatic acid; the gold will soon be covered with a gray film. Remove it from the solution, and dry it carefully in the heated air, above the flame of a spirit-lamp. Introduce the dried metal into a reduction-tube, and apply the flame of a spirit-lamp. A ring of metallic globules will be formed. This test is one of extreme delicacy, and will give a characteristic result, when all other tests fail. It is that which should be preferred for the discovery of very minute quantities of the poison. The metallic deposit may be readily obtained by placing a drop of the acidulated solution on a surface of clean copper or gold, and touching the moistened metal with a fragment of zinc or iron. Dr. Wollaston once employed a key and a sovereign for this purpose. The acid in combination with the mercury may be shown to be the hydrochloric, by testing the fluid from which the mercury has, by any of the foregoing methods, been precipitated; on the addition of the nitrate of silver, we obtain a white precipitate, the chloride of silver, which is insoluble in nitric acid.

§ 456. (3) "*Corrosive sublimate in organic liquids.*—As the poison is very soluble, it is rare to meet with it in a solid form. But when it has been taken in mass, it may sometimes be separated, by merely stirring the liquid, at the same time adding, if it be very viscid, distilled water. The corrosive sublimate, from its great weight, will subside, and may be collected. As the poison is decomposed by the secretions of the body, by the mucous membrane, and by several articles of food, it might not be found in solution in the stomach, even though no antidote had been given. We must, therefore, expect to find it in one of two states; in solution, or in combination with the solid contents of the stomach. In the former case we procure a clear liquid by diluting with distilled water, boiling if necessary, and filtering. In the latter case, one of two processes may be adopted. We may boil the solid matters in distilled water, and in this way bring the soluble salt of mercury into solution; or, if the solid matters treated in this way yield no trace of mercury, in consequence of the soluble salt having been decomposed, evaporate to dryness, and digest the dried residue in warm nitromuriatic acid. The insoluble

ound of mercury is thus reconverted into the soluble ride. This acid liquor must be evaporated to dryness, he residue be dissolved in distilled water, and filtered." orrosive sublimate may now either be dissolved out by or at once tested by the protochloride of tin, or by the ic test.

57. A *new* test has been proposed. If a strong solution of of potassium be added to a minute portion of any of lts of mercury, placed on a clean bright plate of copper, ercury is immediately deposited in the metallic state, ring as a silvery stain on the copper, which cannot be ken, as no other metal is deposited by the same means. is method, it is said, corrosive sublimate may be detected drop of solution, unaffected either by caustic potash, or of potassium. In a mixture of calomel and sugar, in roportion of one grain to two hundred, a distinct metallic will be obtained with one grain, which contains $\frac{1}{200}$th grain of calomel; in like manner $\frac{1}{400}$th of a grain of ide of mercury may be detected, although the mixture gar is not in the least colored by it.

th the preparations of mercury in the undiluted state, process acts with remarkable accuracy; the smallest le quantity of calomel or peroxide of mercury, such as l almost require a magnifying glass to perceive, placed pper treated with iodide of potassium, will give a distinct llic stain. The only precaution which this process seems quire is, that the liquid to be examined should be con- ated by evaporation.(*g*)

58. 5th. Where corrosive sublimate has undoubtedly the cause of death, it has not always been found in the of the deceased. Thus, in a case reported by Dr. Wegeler, young man who poisoned himself with three drachms of substance, and died on the sixth day thereafter, none of oison could be detected in the stomach or intestines.(*h*) other, by Dr. Taylor, where two drachms were swallowed,

(*g*) Pharm. Journ., Feb. 1852.
(*h*) Canstatt's Jahresbericht für 1846, Bd. v. p. 81.

and the man died in four days, no mercury was detected in the stomach or tissues.(*i*)

§ 459. 6th. Orfila (the nephew of the distinguished toxicologist) undertook numerous experiments for the purpose of ascertaining what length of time was required for the disappearance of certain poisons from the system. With respect to corrosive sublimate, he states, that when it has been administered for some time, it will generally disappear from the organs in eight or ten days, and he found it but once on the eighteenth day, after its discontinuance. An individual had undergone a course of treatment with corrosive sublimate, and died four months after ceasing the course. He was poisoned with a mercurial preparation. On analysis, mercury was found in his organs. Hence, according to this author, the mercury could not have been derived from the preparations taken four months before death. He also says, that if a man survives fifteen days after being poisoned with corrosive sublimate, it is quite probable that the experts will find no trace of mercury. They will, however, commit a gross error, if they conclude from this, that there has been no poisoning.(*j*)

XII. *Nitrate of Mercury.*

§ 460. A case of homicidal poisoning, attributed to the administration of a portion of this salt in a pudding, is related in Henke's Zeitschrift for 1849. The symptoms were very similar to those of poisoning by corrosive sublimate; the man survived five days in great agony, and the post-mortem inspection revealed softening and inflammation of the mucous coat of the intestines and stomach. The most curious feature of this case was, that mercury was found in the metallic state in the stomach and intestinal canal, and had been voided also with the discharges during life. This circumstance was attributed by the examiners to the readiness with which the acid, in this combination, is separable from the base, especially under an elevated temperature. A case of suicide by the acid

(*i*) Ibid., p. 322.

(*j*) Am. Journ. Med. Sci., from Comptes Rendus, Jan. 15, 1852.

rate is reported by Mr. Bigsley, in the London Medical te.(*k*)

case is also reported by M. Vidal,(*l*) of the accidental ing by the application of this mercurial salt to the skin. concentrated salt is used as a caustic in surgery, and is ingly active. It is stated that symptoms of mercurial ing have arisen from its use in this form.

1. Other salts of mercury, such as the *white* and *red pre-s*, *cinnabar*, the *bicyanide*, and *turpeth mineral* are all ous, but it is not necessary to enlarge upon them in this They act as irritants or corrosives, and the post-mortem ances in the cases reported are not unlike those found oning by corrosive sublimate.

presence of mercury may be detected as already men-, or by the use of Smithson's battery, which consists of of tin lined with one of gold, in the form of a spiral; has been recommended by Mr. Morgan, of Dublin, by very stain which will immediately appear on a bright f copper, when touched with a strong solution of iodide assium, if mercury be present, either in solution or in id form.

XIII. *Deleterious Effects of Mercurial Preparations.*

2. The subject of chronic poisoning by mercurial pre-ons, and the discussion of questions arising out of the e effects of them upon the system, involves too many erations to be profitably introduced here. We therefore he reader, for information on these points, to Dr. Chris- treatise, and to the standard works on Pathology and ctice of Medicine.

cannot forbear, however, to call the reader's attention articularly to that form of disease known under the f *cancrum oris*, *gangrænopsis*, and *mercurial sore mouth*, lly in reference to children.

3. 1st. That death may occasionally result from the of mercury upon the mouth, there can be no doubt. It mely important, however, to know, if this can be dis-

(*k*) Vol. vi. 329. (*l*) *Vide* p. 407.

tinguished from those forms of inflammation and gangrene of some portion of the buccal cavity which are the result of certain depressed and diseased conditions of the system independent of the action of mercury; and also, whether mercury given to a patient whose vital force is thus reduced, and whose blood is already depraved, may not be the *exciting* cause by which the tendency to gangrenous ulceration becomes developed. It is much to be feared that the inappropriate administration of this drug, has in some cases been followed by serious, and even fatal, disorganization of the mouth; while, on the other hand, physicians may be unjustly blamed for consequences which were really not the result of their imprudence, but of other causes which they were unable to control.

We propose first, by a few cases, to contrast the appearances presented by the effects of mercury on the mouth, with those which are due to disease.

A boy about ten years old, supposed to be suffering under bilious colic, was given twenty grains of calomel, which purged him in four hours; he took, in twenty-four hours, ten grains more with the same effect, but without much relief. On the morning of the fourth day (medical treatment having been continued, but no calomel or any of the acids used) all the symptoms of the early stage of ptyalism set in; the inflammation and swelling of the salivary glands rapidly increased, so that by the day following, there was a general swelling of all the soft parts of the face usually affected by severe ptyalism. On the next morning, a small gangrenous spot, of a dark-brown color, was discovered on the middle and inner surface of the lower lip, which rapidly spread until the seventh day; at this time, the entire lower lip, the inside of both cheeks, and the surface of the tongue, were completely gangrenous, the lower lip and the tip of the tongue were wanting, having been destroyed by ulceration. The ptyalism increased, a stream of viscid saliva was constantly running out of the mouth, and the patient presented a most piteous spectacle. The breath was very fetid and offensive. Death occurred on the twelfth day. In another case, a little girl, ten years old, who received a fracture of the head from a fall, was given some calomel for the purpose of opening the bowels, but

it did not operate. Her mouth became sore, and got rapidly worse, notwithstanding every effort was made to relieve it. The throat and face became immensely swollen, the teeth became loose and several came out, and the whole inside of the mouth, tongue and all, had a very black appearance, emitting a constant flow of a dark, putrid saliva of intolerable fetor. The greater part of the mouth and tongue mortified, and part of the tongue, the under lip, and part of one side of the face, sloughed off, presenting a most horrible spectacle, and one exquisitely distressing to the parents and friends of the little patient—the more so, as the child continued to live some days after these parts had become detached.(*l*[1])

§ 464. That form of disease due to the action of mercury upon a depraved constitution, may be illustrated by the following cases.(*m*) A boy, aged thirteen years, after suffering from influenza and partially recovering, was attacked with gastro-enteritis, from over-indulgence in animal food. The bowels were moved daily with about two grains of calomel, followed by a teaspoonful of castor oil when necessary. He amended under this treatment; but, about three weeks after the commencement of his sickness, it was discovered that mortification had commenced under the tongue, near the third molar tooth, on the left side; it extended around all the molar teeth of that side, embracing the gum and a portion of the cheek. The cheek was slightly swollen, and the left eye was opened with some difficulty. The mortification spread rapidly, notwithstanding the use of caustics, a dark spot appeared on the outside of the cheek, and the patient died on the third day. It is stated that the boy had dug out a piece of a tooth with a knife, a few days before the mortification began, at the place where it commenced. About twenty grains of calomel were taken during the first week of the disease, and none afterwards. The glands were not affected; and the mouth, when the mortification commenced, presented a healthy appearance.

Dr. S. Jackson (late of Northumberland) says: "I applied

(*l*[1]) Bost. Med. and Surg. Journ., vol. xxxii. pp. 459 and 517.
(*m*) Ibid., p. 342.

mercurial ointment to the face of a child, about three years old, to prevent the pitting of confluent smallpox; in a few days the gums were swelled and the teeth loosened, but only on the side upon which the patient continually lay. The gums soon mortified, the gangrene spread to the cheek, bringing on a fair case of gangrænopsis, and she died of her twofold disease in a very few days. This," he says, "was not a case of salivation, for the other side of the jaw remained sound, and the teeth on that side firm in their sockets."(n) In the same manner were fatal ulceration and gangrene developed, in a case reported by Dr. Marshall Hall. A child four years of age, with hooping-cough, took, according to a prescription furnished from a dispensary, three grains of calomel, on the 29th of October, and the same dose four times thereafter until the 7th of November. About this time the right cheek became much swollen, and there was great difficulty in opening the mouth, with very offensive breath. The gums and inside of the cheek became ulcerated, and on the 16th a sphacelus appeared on the right cheek, of about the size of a shilling, which rapidly extended to the size of a crown. The child continued to get worse, and died on the 23d. On post-mortem examination, there was found pleuro-pneumonia of the lower lobe of the right lung; there was an extensive eschar in the right cheek; its size, externally, was two and a half inches in length by one and a half in breadth. It penetrated through the entire cheek, and occupied an equally extensive space on its internal surface; the contiguous gum was in a similar state of sloughing, the alveolar processes were denuded, one or two teeth had disappeared, and several adjacent ones were loose. On the left side there was incipient gangrene of the cheek internally, and also of the contiguous gum, and the teeth were loose. The rest of the mouth was not affected.

§ 465. 2d. Cases of true gangrene of the face, however, have a different origin and course. A single example will suffice. It is taken also from Dr. M. Hall's Observations in Medicine. A little girl, aged three years and a half, had been affected with *fever* about fourteen days, and was apparently convales-

(n) Trans. Coll. of Phys. Philad., U. S., vol. ii. No. 3.

cent, when the left side of the face and lips was observed to be swollen, and to have a red and glistening appearance. About the same period, three spots were observed, one on the gum of the lower jaw, and the other two on the left cheek. These spots became dark-colored, and gradually spread. A slough separated from the cheek, and exposed the inside of the mouth. The contiguous teeth fell out. The breath and the exhalation from the ulcer were extremely offensive. The child lingered about fourteen days, and sank gradually.

Having thus seen the various forms of disease of the mouth which may give rise to a suspicion of poisoning by mercurial preparations, it only remains for us to point out the means by which the symptoms caused really by such preparations, may be distinguished from others which are spontaneous in their origin.

§ 466. All authors agree that mercury does not produce salivation in children as readily as in adults. Dr. Clarke says, that, although he has prescribed mercury in very large quantities in a great number of cases, he never produced salivation, except in three instances, in any child under three years of age. Dr. Warren, of Boston, observes: "That he has never known an infant to be salivated, notwithstanding he has given, in some cases, large quantities with this view." Mr. Colles, of Dublin, says: "No man in the present day requires to be told that mercury never does produce ptyalism or swelling and ulceration of the gums in infants." Drs. Evanson and Maunsell say: "Mercury does not seem capable of salivating an infant; we have never seen it do so, nor are we aware of any such case being on record."(o) Dr. West, of London, says: "In infants under five years of age, the gums hardly ever become affected by mercury, though most energetically employed; and it has never yet occurred to me to meet with an instance of profuse salivation or dangerous ulceration of the gums. Such accidents, however, do now and then occur, and have been known to terminate in fatal gangrene of the cheek or necrosis of the jaw." Yet, when salivation does occur, there is quite sufficient testimony, which it is unneces-

(o) Beck's Essays on Infant Therapeutics, p. 48.

sary to quote, that the most disastrous consequences may follow. In this fact, however, appears to lie the great distinction between the disease resulting exclusively from the use of mercury, and that which is spontaneous or merely called into action by it. Dr. Hall says: "It is well known to every observer that the effect of calomel, when it does take place, is *uniformly diffused* over the *gums*, *tongue*, and internal parts of the cheek." Further, "it is *diffused* and is totally different in many respects from the *circumscribed* form of the gangræna oris." In other words, the mercurial disease commences in the gums and tongue; they swell, ulcerate, and slough, and the disease may then extend itself to the lips and cheek. The disease is therefore different in its early manifestations, is attended with salivation, is slower in its progress, and at first confined to parts which in true gangrænopsis are only secondarily affected.

§ 467. We take the following description of *gangrænopsis* from the admirable monograph of Dr. Jackson, which we have already referred to:—

"I. The gangrænopsis attacks the cheek, the lip, or the nose, sometimes the fauces; most frequently in children, but sometimes in adults.

"II. It begins in those soft parts, and never in the maxilla, often where no mercury has been used, in a debilitated and febrile state of the system, as in idiopathic fevers and dysentery. Van Swieten saw it in scurvy, and Huxham in measles. Dr. Marshall Hall says (p. 178): 'In all the cases which came to my knowledge, this affection had been preceded by fever, acute disorder of the digestive organs, inflammation of the lungs, variola, rubeola, or scarlatina.' An exhausted state of the vitality, with cachectic fever, is, therefore, the predisposing cause.

"III. The exciting cause is any injury done to the parts. I saw it evidently started in two cases by the child's lying continually on one side, with a hand under the cheek, thus pressing the mucous membrane against the molar teeth; a protuberance of this membrane being caught between the teeth, was continually bruised, and a point of gangrene was thus established in an exanimate state of the whole system.

"IV. It is sometimes the result of severe cases of cancrum oris, the irritation spreading from the gums to the cheek."

It is well known that cancrum oris and the gangrene which attacks the cheek often occur in cases where no mercury has been given. We think that there is between these two essentially little pathological difference; the most tangible distinction being, as it appears to us, that the canker sore-mouth of children (as it is called) sometimes prevails endemically in low unhealthy situations, and among the poorer classes, being frequently seen in the hospitals for children, and occurring without being necessarily preceded by disease; whereas the gangrene of the cheek is commonly a sequel of exanthematous or other prostrating diseases. Both are allied closely to the gangrene of the genitals in female children, elsewhere referred to. (*Vide* RAPE.)

§ 468. It is evident, we think, from what has been said, that the diagnosis of the cause of these various forms of disease is not always easy. It depends chiefly upon the possibility of ascertaining the manner in which the disease first manifested itself—whether by swelling and ulceration of the gums generally, with an increased flow of saliva, or whether it commenced in the mouth or cheek with a hard red swelling, rapidly running into gangrene. The character of the disease under which the child was suffering, and its hygienic conditions, must also be known.

If an opinion is required only after death, or at an advanced period of the disease, it may be impossible to know whether it can be attributed to mercury, or whether, in case it is known that mercury has been exhibited, it can be fairly attributed to it. Dr. Taylor does not admit the validity of the criterion that mercurial poisoning can be known by the *uniform diffusion* of the disease over the gums, tongue, and internal parts of the cheek, as advocated by Dr. Hall; and Dr. Christison, he says, has recorded a case in which, although the gangrene resulted from mercury, it was observed to occur on the skin near the mouth, on each side, whence it spread over the whole cheek, and destroyed life in eight days (p. 319). He also gives a case in which a charge was made against a medical practitioner, of having caused the death of a child aged four

years by administering an overdose of some mercurial preparation. The child was laboring under hooping-cough, and some medicine was prescribed; on the fourth day the child complained of soreness of the mouth, the teeth became loose and fell out, the tongue and cheek were very much swollen, and the child died in the course of a few days from gangrene in the left cheek. The answer to the charge was that not a particle of mercury had been exhibited; a fact clearly proved by the production of the prescription book of the medical attendant.

Niemeyer(*p*) describes the appearance of mercurial stomatitis. "In the milder grades of the diphtheritic form of mercurial stomatitis, at certain portions of the mouth, along the lateral borders of the tongue, and on the parts of the cheeks and lips which lie against the teeth, we at first find a whitish or somewhat dirty discoloration of the mucous membrane. These white spots cannot be wiped off, but after a few days the superficial layer of mucous membrane, with the exudation infiltrating it, falls off, and in its place is left an unhealthy-looking ulcer, which cleans off slowly and finally cicatrizes from the margins. In more severe cases, where the exudation infiltrates and destroys the whole thickness of the mucous membrane, a large portion of the inner surface of the mouth is often converted into a soft discolored slough. If this separates, a deep ulcer with irregular borders and uneven base is left. The lost substance is but slowly filled with granulations, and as the lost mucous membrane is not regenerated, but is replaced with cicatricial tissue, contracted cicatrices, or even adhesive and *false anchylosis*, not unfrequently remain.

"In *cancrum oris* the infiltration and ulceration always begin on the gums, usually at their upper border on the anterior surface. In severe cases it advances to the posterior surface of the gums, and the adjacent parts of the lips, cheeks, and tongue. The teeth become loosened, and occasionally the periosteum of the jaw is exposed and destroyed. In consequence of this,

(*p*) Text-book of Practical Medicine, translated. Humphreys and Hackley, 1869, i. p. 422.

in some cases there are *caries* and *necrosis* of the maxillary bones."

Chlorate of potash is an almost certain remedy against *cancrum oris*.

XIV. *The Salts of Lead.*

§ 469. 1st. *Form.—Acetate or sugar of lead* is a white crystalline salt, of a sweet, astringent taste, and soluble in water and alcohol. The solution in ordinary water is turbid, owing to the formation of the carbonate of lead. It resembles loaf-sugar in appearance, a circumstance which has sometimes led to its being swallowed in mistake for it. Its constant use in medicine, and the facility with which it can be procured, are the chief causes of the frequent cases of poisoning observed from it.

§ 470. 2d. *Symptoms.*—In general the poisonous effects of acetate of lead arise gradually and become slowly developed after its long-continued use. When taken in a large quantity at once, it is capable of producing symptoms analogous to those caused by other irritant poisons. It is eliminated from the system by the urine, by the perspiration, and by the milk. The constitutional effects of lead have been thus described by Tanquerel des Planches:—(*q*)

1st. Saturnine coloration of the gums, of the buccal mucous membrane, and of the teeth. A narrow leaden-blue, or slate-blue line, from one-twentieth to one-sixth of an inch in breadth, is formed on the margins of the gums nearest to two or more teeth (usually the incisors) of either jaw. The inner part of the lips and cheeks is sometimes stained blue. The blue discoloration is supposed to depend upon the formation of the sulphuret of lead.

2d. Saturnine taste and breath.

3d. Saturnine jaundice.

4th. Emaciation most evident in the face.

5th. Slowness, smallness, and irregularity of the pulse.

The true saturnine diseases which follow may either exist alone or be complicated with each other. They are: 1st. Lead

(*q*) Traité des Malad. de Plomb, Paris, 1839.

or painter's colic. 2d. Lead rheumatism. 3d. Lead palsy, often accompanied with loss of sensation in the part affected. 4th. Disease of the brain—*encephalopathia saturnina*—manifested by delirium, coma, or convulsions, and the loss of one or more senses.

§ 471. Dr. Wm. Norris, of Stourbridge, gives an account of the poisoning of a vast number of persons, by acetate of lead accidentally mixed with flour. About thirty pounds of this salt were mixed with sixty or eighty sacks of flour, which was retailed to a great many persons in the neighboring villages. Nearly a thousand persons suffered from the poisonous effects of lead. The persons who ate the bread, after a few weeks complained of a peculiar taste; some compared it to soda, others to rusty needles or copper. The tongue was covered with a darkish cream-colored mucus, and was soft and flabby; the gums were swollen, with a blue line on the margin, and in many cases the blue tinge extended nearly over the gums, and occasionally on the inner side of the lower lip, and in a faint degree over the mucous membrane of the mouth and towards the fauces; the tonsils were in some cases enlarged, and in other cases there was salivation. These symptoms were accompanied by loss of appetite, nausea, vomiting, flatulency, and obstinate constipation, with a sense of constriction in the throat and epigastrium, and a violent spasmodic pain and twisting around the navel, which was retracted; the pain was sometimes increased by pressure, and when the paroxysms were violent, the muscles of the abdomen were contracted spasmodically, and a most frequent symptom was pain in the loins about the situation of the lumbar fascia, and in the deltoid muscles. The patients were chilly, with great languor and lassitude; the skin dry; the intellect was clear, but there was general depression, and the pulse was low and feeble; the features were sallow and shrunken; and the muscles flabby; the fluid vomited was often mixed with bile and occasionally, a coffee-ground secretion; the feces were dark and highly offensive, with scybala; the urine scanty and of a dark-red color almost like porter.(r) It is well known that the acetate

(r) Prov. Med. and Surg. Journal, June 27, 1849.

of lead is frequently administered in disease in small doses, for a considerable length of time without any symptoms of poisoning arising from it.

§ 472. An interesting case of imputed poisoning by acetate of lead may be found in Dr. Maclagan's "Contributions to Toxicology," in the *Ed. Month. Journ.* for Dec. 1848. Although the falsity of the charge was shown by many circumstances, which it is not here necessary to relate, there was one which in itself would have had great weight in its refutation. The acetate of lead was said by the prosecutor to have been given to him in coffee. Now acetate of lead is the very agent employed to decompose and decolorize coffee, in preparing its characteristic constituent caffeine. The precipitate which the lead salt forms in its infusion, if it is allowed to rest, subsides, and leaves a pale-colored fluid in no respect resembling that which people are accustomed to drink as coffee. One ounce of ordinary coffee was boiled for ten minutes in the coffee-pot, which had been used, with six cupfuls of water. It was allowed to settle for five minutes, and then poured off. It had the ordinary appearance of unclarified coffee, dark-brown, and slightly turbid, and depositing some coffee-grounds. "Half an ounce of sugar of lead, being the same proportion to this bulk of fluid which was found in the coffee got from the prosecutor, was now added; the coffee was boiled again and allowed to settle for five minutes after removal from the fire. Another similar portion, being decanted, was now found to be a clear transparent liquid, with hardly any color, except a faint shade of green, and more resembling a weak infusion of green tea than coffee. It was obvious, therefore, that if, during the breakfast, the coffee-pot remained at any time at rest for five minutes, the next cupful poured off must have been so different in appearance from ordinary coffee as at once to attract attention." This decolorizing property of the sugar of lead should therefore not be lost sight of in any future case of alleged poisoning by its mixture with coffee.

§ 473. Occasionally, however, symptoms of poisoning are seen, and, in a case reported by Dr. Letheby, with a fatal termination. A child six years of age was given one-fifth of a grain two or three times a day for nearly nine weeks. It

became emaciated, had colic and constipation, the stools were black and offensive, the breath fetid, and towards the last it became drowsy and its limbs were paralyzed. Upon the day of its death it had convulsions, and shortly before death, fell into a state of coma.(*s*) An instance of recovery from an ounce and a half of sugar of lead, swallowed in mistake, is related by Dr. Taylor.(*t*) The woman fell ill almost directly, had a nauseous metallic taste in her mouth, with a burning heat in it, the throat, and the stomach. On taking some water to wash away the taste, vomiting was brought on. The mouth became very dry; she had great pain at the pit of the stomach, and excessive vomiting. Two hours afterwards, she felt sleepy and stupid—alternately perspiring and shivering; she complained of violent colic, which was relieved by pressure. With great languor, she had also cramps in the thighs, and numbness over the whole body, with giddiness. The gums were tender, and had, apparently, a blue line on their edge; there was some salivation, and the breath was foul. There were other symptoms such as have been before detailed. She was relieved by treatment in a few days. Several other cases of the same kind are reported, which it is needless to describe. They all recovered.

§ 474. It is necessary in distinguishing poisoning by lead to consider that the forms of its administration are twofold, viz., the acetate of lead which is the most common agent for homicides and suicides; and the oxides, carbonates, and other lead compounds used in the arts and in domestic economy.

When it is remembered how varied are the means for the employment of lead in the industrial pursuits, it may not be surprising to find that chronic lead poisoning is very common. The only subject in this respect with which we are immediately concerned is that of absorption. There is now very little doubt in the minds of the most experienced physicians that lead can be absorbed by inhalation of lead vapors, and also by contact of the metal with the skin.

§ 475. The two forms of lead poisoning are acute and chronic. The acute form results from the ingestion of a solu-

(*s*) Pharm. Journ., Dec. 1845. (*t*) p. 848.

ble salt of lead or of some drink with which it has been mixed accidentally in considerable quantity, such as cider, wine, or vinegar. Very soon after nausea, not always accompanied with vomiting, supervenes, followed by very acute pains in the abdomen; sometimes there is diarrhœa, but more often obstinate constipation. The countenance becomes pale and oftentimes from the moment of attack there may be noticed a bluish line upon the borders of the gums.(*u*) The voice becomes indistinct, a painful hiccough supervenes; syncope and terrible convulsions precede a state of comatose stupor, which may endure for two or three days and terminate in death. (Tardieu.)

In the slow form of lead poisoning, several days sometimes may elapse before the symptoms are noticed, but more generally it is after two or three months of sojourn in an atmosphere vitiated by the saturnine emanations, or of contact with lead, that the first symptoms of poisoning become apparent. These are preceded by characteristic signs of saturnine affections, such as gradual pallor and emaciation, the skin (of the face especially) of a pale yellow (subictérique), in which the sclerotic coat of the eye participates. The serious symptoms commence with lead colic, followed by epileptic convulsions and a comatose or delirious condition. It is a matter of observation that from the commencement there exists a certain absence of the sensation of pain, sometimes of the whole surface of the body, but more especially of the arms and forearms. (Tardieu.)

Anatomical lesions.—These are not pronounced or characteristic. Rarely there is found a slight and superficial inflammation of the stomach, but according to Taylor this occurs only in those cases where the acetate of lead has been made acid and irritant by an excess of acetic acid.

With the acute poisoning the only diseases likely to be confounded are simple enteric or gastric fever. The lead poisoning can be distinguished from these by the much more acute pains in the abdomen, the state of the mouth, the line on the

(*u*) This line is not always indicative of lead poisoning, as in certain persons of uncleanly habits it may exist without suspicion of lead poison.

gums, the fetor of the breath, and the serious nervous disturbances, especially their more rapid progress.

§ 476. The salts of lead are easily recognized by the following chemical properties:—

Caustic potash gives in solutions of lead a white heavy precipitate, hydrate of the oxide of lead, which is completely soluble in an excess of the reagent.

Ammonia gives a white precipitate, insoluble in an excess of the reagent.

The alkaline carbonates precipitate white carbonate of lead, almost completely insoluble in an excess of the precipitate.

§ 477. To recover lead from organic matter supposed to contain this metal, the following process is laid down by Tardieu. "Divide the solid portions into small pieces, which can then be immediately mixed in a mortar with half their weight of pure and dry carbonate of soda. The pulp that results is first dried in a water-bath as completely as possible, and then placed in a covered porcelain crucible; the mixture should occupy but half the capacity of the crucible. This is then gradually heated either in a little furnace or over a Berzelius lamp, in such a way as to prevent overboiling, and then increasing the heat until the carbonate of soda becomes fused. As soon as the fusion is complete, the fire is gradually withdrawn; care must be taken not to allow a continuance of the heat much beyond the fusion, as some of the reduced metal will become volatile. After the crucible has become quite cold, it is withdrawn from the furnace and carefully wiped, and it may then be placed in a large porcelain capsule containing boiling distilled water. The ebullition is continued until all the vitreous mass in the crucible is completely dissolved (this can easily be ascertained by removing the crucible and by examining the substance in its interior). By means of a washing bottle the exterior and interior of the crucible are thoroughly washed, the latter being kept in the capsule. The crucible is then allowed to dry. The liquid in the capsule, after being allowed to stand for some time, is cautiously decanted, so as to remove the charred portions and the soluble salts, and to preserve the heavier metallic portions which sink to the bottom. At the

end of several washings and decantations, the metal, if present, is found in little bright particles which may easily be collected and dried upon bibulous paper. The crucible had better be examined, as some of the lead globules may have adhered to its sides. If the metallic particles are too small to be easily handled and observed, it is a good plan to reunite them with a little pure and dry carbonate of soda in a cavity of a bit of charcoal, and by the blowpipe to collect them in one or two large globules. Thus obtained they can easily be produced in a court of investigation.

When lead has been found in a suspected case of poisoning, it is of course important to show that the peculiar occupation or profession of the individual would not explain the presence of this metal in his organs. The experiments of the younger Orfila show that eight months is the shortest time of the sojourn of lead in the liver, the intestines, and bones.

§ 478. The symptoms which follow the introduction of the *carbonate* or other slightly soluble salts of lead into the body, are precisely similar to those already mentioned; occurring soon when the dose is large, and gradually when entering the system by water, wine, cider, or other liquids which are apt to be impregnated with them, and also when inhaled by the lungs. The subject of chronic poisoning by lead in these ways is one which has indeed its interest for the physician, in its relation to medical police, but the facts relating to it are too fully detailed in the comprehensive works on poisons and the treatises upon the practice of medicine, to require elucidation at our hands.(*v*) The character of the poisoning differs so completely from that of the irritant poisons, that no mistake on this point can ever be made; the only embarrassment which

(*v*) Besides the chief authorities which may be consulted on this subject, are the following: Tanquerel des Planches, Traité des Maladies du Plomb (also translated by Dr. Dana, of Boston); Dr. Burton, Med.-Chir. Trans. vol. xx.; Gueneau de Mussy, Dub. Quart. Journ., vol. vii. p. 405; Dalton, Am. Journ. Med. Sci., Oct. 1849; Alb. Smith, Month. Journ., March, 1853; Bois de Loury, Rev. Med., Juillet, 1852; Aldersoa, Lancet, July, August, Sept. and Oct. 1852. For some cases of poisoning by visiting cards (glazed with lead), *vide* Med. News, 1854; or Med. Times and Gaz., July, 1854. Eichmann.

ever presents itself being the discovery of the particular way in which the lead had been introduced into the system.(*w*)

§ 479. 3d. *Post-mortem appearances.*—There are few poisons productive of so much suffering, and, when fatal, of such violent symptoms towards the close of life, and yet leave in the body such indistinct traces of their action as these. In a case which terminated with the symptoms of saturnine *encephalopathia*, viz., delirium, insensibility, and tetanic convulsions, Empis and Robinet found no anatomical alterations of any importance. Lead was discovered, by incineration, in the brain and liver.(*x*) Likewise, in another case examined by Dr. Hopfgartner, of Vienna, lead was found in the same organs, but no pathological alterations, except that one of the lateral columns of the spinal marrow appeared to be wasted.(*y*) In Dr. Letheby's case, lead was freely detected in the contents of the stomach, in the brain, muscles, liver, intestines, blood, and in the serum of the cerebral ventricles. The stomach and intestines were pale and nearly empty, and the latter contracted, and in some places invaginated.

§ 479*a*. 4th. *Chemical examination.*—Sugar of lead is very soluble; it has an astringent and sweetish taste, and a slight odor of vinegar. In the solid state it may be reduced in the blowpipe flame with carbonate of soda, globules of metallic lead being immediately formed with a yellow incrustation of the oxide. In solution, it may be detected by several reagents: *hydrosulphuric acid* throws down the black sulphuret of lead, and *chromate of potash* a yellow precipitate of the chromate of lead. These latter tests produce the same results with bismuth; but the basic oxide of bismuth is precipitated by a large quantity of water alone, while the oxide of lead is completely precipitated by sulphuric acid. *In organic mixtures*, however, as acetate of lead forms insoluble compounds with

(*w*) For additional illustrative cases, consult Lepage, Annuaire de Therap., 1857, p. 224; Inman, Liverpool Journal, Jan. 1857, p. 26; Meyer, Am. Journ. Med. Sci., Oct. 1857, p. 542 (in this case the poison was mixed with snuff); O'Connor, Dublin Quart. Journ., May, 1859, p. 482; Lindsay, Brit. and For. Med.-Chir. Rev., Oct. 1859, p 532; Times and Gaz., March, 1858, p. 296; Aldis, Jan. 1860, p. 33; and Ibid., p. 60.

(*x*) Arch. Gén., Sept. 1851, p. 67.

(*y*) Wiener Zeitsch., Sept. 1852.

albumen and other animal principles, these must be redissolved by a little nitric acid and the mixture filtered. It should then be tested by hydrosulphuric acid, and if a dark-colored precipitate is formed and the precipitate is reduced before the blowpipe flame on a piece of charcoal, a malleable globule will be thus procured if lead be present. Although this test is quite satisfactory and easily applied, another one may be employed as recommended by Dr. Christison. The black sulphuret of lead should be collected on a filter, washed and dried, and then heated to redness in a tube, and digested with nitric acid by the aid of a gentle heat. "The lead is thus dissolved without the sulphur being acted upon. The solution is then to be diluted with water, filtered, evaporated to dryness, and gently heated, to expel the excess of nitric acid." It can then be tested by the reagents before mentioned. Care must be taken to expel all the excess of nitric acid, because an excess will show a yellow color with the hydriodate of potash, though lead be not present. The same process may be used for any of the soluble salts of lead.

In the *tissues*, lead may be detected by incineration in a crucible with black flux. It will, of course, if present, be found at the bottom, in the metallic form. There is no reason to suppose that it may not be detected several months after death. It appears to be the opinion of the most eminent toxicologists, with the exception of Orfila, that this metal does not exist as a normal constituent of the tissues of the body.

XV. *The Salts of Copper.*

§ 480. The most common of these salts, met with in cases of poisoning, are the sulphate (blue vitriol), the subcarbonate, and the subacetate of copper (verdigris). Arsenite of copper (Scheele's green), and the mixture of this with the acetate of copper (Schweinfürt's green), have been mentioned in connection with arsenical poisoning. Verdigris is formed in alloys of copper by the combined action of air and dampness, or by the maceration of copper in acetic acid. It has been made by allowing copper weights to steep in vinegar. Verdigris has been used in cooking to give to green vegetables a more brilliant green color. M. Derheims has recorded a case of poisoning by

liqueur d'absinthe, colored with blue vitriol. Bakers sometimes add sulphate of copper to dough, to whiten the bread and increase its weight, as the flour will thus absorb a larger quantity of water.

§ 481. It is seldom that these poisons are designedly administered with homicidal intentions, since their detection, both by the color and taste, is too easy to permit it. A husband attempted to poison his wife by adding verdigris to a dish of beans. The bad taste prevented her from eating them. He buried the cooked mess in his garden, from which it was disinterred, and then examined by chemists. They proved the certain presence of the metal. He was condemned to hard labor for life.(*a*) Cases of poisoning from these salts may then be divided into those in which a large dose is swallowed, either by accident, or with a view to suicide, and those which proceed from the contamination of food by copper vessels, or by the salts of copper used as coloring matters for confectionery, etc.

1st. The *symptoms* come on, in the first instance, much sooner after the ingestion of the poison than in the latter. There is violent headache, vomiting and purging, severe colicky pains, eructations, salivation, cramps in the limbs, and finally convulsions and insensibility. Sometimes jaundice is observed. In a case related by Dr. Percival, two drachms of sulphate of copper produced fatal convulsions. In another, where the same salt was swallowed, there were no convulsions. The child, which was sixteen months old, died in four hours.(*b*) Those cases which have terminated fatally have lasted a variable period. Thus in one reported by Pyl, a woman who swallowed two ounces of verdigris, died in *three* days; in another, by Neumann, half an ounce destroyed life in *sixty* hours; and in another, in which an ounce of blue vitriol was taken, death ensued within *twelve* hours.(*c*) In most cases, however, of poisoning with these salts, the patient has recovered, when timely and efficient means have been used.

In those cases in which the poison has been conveyed acci-

(*a*) Journ. de Chimie, Chevalier, 1854.
(*b*) Med. Gaz., vol. xviii. p. 742.
(*c*) Quoted by Beck.

dentally, through articles of food, into the system, the symptoms have been the same as those mentioned, although they have usually not come on until a few hours afterwards. They are thus described by Orfila: "An acrid, styptic, coppery taste in the mouth; parched and dry tongue; a sense of strangulation in the throat; coppery eructations; continual spitting; nausea; copious vomiting, or vain efforts to vomit; shooting pains in the stomach, which are often very severe; horrible gripes; very frequent alvine evacuations, sometimes bloody and blackish, with tenesmus and debility; the abdomen inflated and painful; the pulse small, irregular, tense, and frequent; syncope, heat of skin, ardent thirst, difficulty of breathing, anxiety in region of the præcordia, cold sweats, scanty urine, violent headache, vertigo, faintness, weakness of the limbs, cramps of the legs, and convulsions." Such are the symptoms which, it is said, are produced by the ingestion of articles of food contaminated with copper salts. How far they are *really* due to this cause we shall presently inquire.(*d*)

§ 482. 2d. *Post-mortem appearances.*—The mucous membrane of the stomach and intestines is inflamed and thickened, in some places eroded, and in a case quoted by Orfila, the small intestine was perforated. If the patient has not survived long, the mucus of the intestines will be found tinged of a green color. The digestive tube is generally distended by an enormous quantity of gas, and the mucous membrane of the alimentary canal is often red and inflamed, sometimes throughout its whole extent; at other times some ecchymoses distributed in the submucous cellular tissue are noticed, and also ulcerations and gangrenous patches. But the most important and remarkable appearance is the predominance of inflammatory lesion over bloody extravasations, the latter of which rarely occur and are met with in exceptional cases under the serous coat of the intestines, lungs, and heart. (Tardieu.)

(*d*) In a very instructive article by Dr. Hönerkopf (Casper's Vierteljahr, viii. 212), it is maintained that sulphate of copper cannot in a strict sense be considered a poison. He refers to numerous cases in which this medicine was taken in large or repeated doses without harm, and usually with benifit, and shows that the greater number of symptoms ascribed to it are not really observed.

No other changes worthy of note have been observed. A fatal case is reported by Mr. Cockburn,(*e*) in a woman who swallowed two or three drachms of sulphate of iron, with seven of sulphate of copper. The symptoms were such as are described above, and death took place in about twenty-four hours. Yet there was no disorganization whatever of the mucous coat of the stomach and intestine.

The salts of copper which are stated most frequently to give rise to accidents are the *sulphate* (which is sometimes used for the purpose of procuring abortion), the *subchloride*, the *subacetate*, or verdigris, and the *arsenite*, or Scheele's green, which last is elsewhere considered.(*f*) It is seldom that the case can be so doubtful as to render a chemical investigation necessary, except when, one or more persons having been taken ill after partaking of a meal, it is suspected that some poison may have been intentionally introduced into their food or drink.

§ 483. The use of copper utensils in the preparation of food has occasionally given rise to serious consequences, on account of the impregnation of the food by some poisonous salt of this metal. If the vessels are bright and clean, very little harm can possibly result from this cause, if ordinary articles of food are boiled in them and not allowed to remain in them after they become cool. Saline, acid, or oily matters act, however, upon copper vessels, and if these are not clean, having been already exposed to moist air and become covered with the carbonate, the food may be impregnated with this poisonous salt in sufficient quantity to produce alarming symptoms. Such will be especially the case if articles of the kind have been allowed to remain in the vessels to cool. It need hardly be stated that tinning the vessels is the only certain mode of preventing such effects.

There can be little doubt, we think, that the frequency of accidents from this cause is much exaggerated, and that in many cases the sudden illness which is mistaken for the symptoms of copper poisoning is really due to the unwholesome nature of the food eaten, or to other causes. We are led to this belief not only from a consideration of the extremely

(*e*) Lancet, Aug. 1856, p. 248.

(*f*) *Vide* Arsenic.

small quantity of copper that in most cases can be dissolved, but also from the reflection that unwholesome food is capable of giving rise to a set of symptoms very nearly similar to those produced by copper, and finally, from the fact that in several cases of suspected poisoning by copper, this metal could not be detected by chemical analysis, in portions of the food used.

Prof. Langenbeck, of Göttingen, reported an instance of the poisoning of thirty-one persons, who had eaten a portion of beef sausage. This sausage meat had been fried in lard which had stood for two days in a badly tinned copper vessel, and was said to have become green in consequence. The poisoning was therefore attributed to copper. Dr. Paasch, in order to estimate the amount which each person in this instance must have taken, makes the following calculation. He assumes as barely possible that one scruple of metallic copper could have been dissolved by means of the fatty acids existing in the lard. This amount would correspond with twenty-five grains of oxide of copper, or fifty-seven and a half grains of anhydrous, or sixty-three grains of crystallized acetate of copper. Supposing that the whole of this had been taken up by the food, and entirely consumed, each person would have swallowed *two* grains of verdigris.(*g*) That so small an amount should be capable of producing alarming symptoms of poisoning is hardly possible, when we reflect how much larger doses of this, and other equally poisonous salts of copper, have been given without harm, in medical practice. Gerbier is said to have given the subacetate in doses amounting to twenty and even thirty grains in the twenty-four hours, and Solier de la Romillais ten to twelve grains a day.(*h*) The sulphate of copper is frequently given in doses of fifteen grains at a time, for the purpose of procuring emesis, in narcotic poisoning. Richmond gave as much as a scruple of carbonate of copper daily, to patients suffering with obstinate neuralgic affections, and Key, for the same purpose, administered as much as half an ounce daily, divided into three doses, continuing the treatment

(*g*) Casper's Vierteljahrschrift, Jan. 1852.

(*h*) Guersent, Dict. des Sci. Méd., art. Cancer.

for a fortnight, with no other result than the cure of the disease.(*i*) Pereira says that he administered six grains of the sulphate of copper thrice a day for several weeks, in an old dysentery, without any other obvious effect than slight nausea and amelioration of the disease for which it was given. If the symptoms arising from the use of unwholesome food, such as sausages, old cheese, and the like, be now compared with those which are ascribed to poisoning by copper, a very great similarity will be found between them.(*j*) Dr. Paasch relates instances in which the conviction was so strong that the symptoms of poisoning must have been due to a salt of copper, that a chemical investigation of the food was undertaken, which resulted, however, in the fact that not a trace of copper could be discovered.(*k*) Dr. Taylor, in his work on poisons, states that he was required to examine the following case: "In an extensive poor-law union, a number of the paupers had been seized with diarrhœa and dysentery, and several of them died. There was no apparent cause for this sickness and mortality; and it was suspected that the soup, which was daily prepared in large copper boilers, might have become impregnated with the metal, and have given rise to the symptoms, although these were scarely indicative of irritant poisoning. I ascertained that the copper vessels were cleaned out daily, that the soup was made with salt and other vegetables, but was poured into other vessels to become cool." The soup, however, gave no trace of copper by the iron test, was unaffected by a current of sulphuretted hydrogen gas, and the incinerated residue, after evaporation and calcining, gave no sign of the existence of copper to any of the tests.

While these considerations throw doubts upon the frequency of poisoning by food impregnated with copper, from the use of cooking utensils of this material, they do not, of course, destroy the well-attested fact of its occasional occurrence. It appears evident, however, that the slightest attention to cleanliness in the keeping of such articles is all that is necessary to secure immunity from danger.

(*i*) Dict. de Méd., art. Cuivre.
(*j*) *Vide* Poisonous Food. (*k*) Loc. cit.

The use of verdigris or other salts of copper for the coloring of confectionery or of other edible articles is manifestly a very pernicious practice. A highly interesting case, in which a whole family was poisoned, and two of its members died, from the use of vegetables thus colored, is reported by Kramer.(*l*) Dr. Percival found a strong impregnation of copper in pickled samphire, of which a young lady ate one morning a considerable quantity, and which proved fatal in nine days. Dr. Falconer once detected so large a quantity in some pickled cucumbers, bought at a great London grocer's, that it was deposited on a plate of iron, and imparted its peculiar taste and smell to the pickles. It seems, indeed, to have been at one time the custom to make a point of adulterating pickles with copper; for in many old cookery-books the cook is told to make her pickles in a copper pan, or to put some half-pence among the pickles, to give them a fine green color.(*m*) Many of the cases of poisoning by confectionery are due to the arsenite of copper, or Scheele's green, which we have elsewhere treated of.(*n*)

§ 484. Numerous cases are related in which *copper coins* have been swallowed, with the symptoms of copper poisoning resulting. On the other hand, a case is mentioned by Dr. Jackson, of Boston, in which a half-cent swallowed by a child produced nausea and vomiting, another by Dr. Budd and others,(*o*) and another by Dr. Hartshorne, in which a boy five years old died with all the symptoms of poisoning by copper, just two years after having swallowed a brass button.(*p*) A curious case is related by Deutsch, of a boy six years old, who swallowed a number of small copper coins. His medical attendant prescribed vinegar and other organic acids! In consequence of this singular treatment, he was seized with alarming symptoms, violent colic, and vomiting and purging of greenish-colored mucus. Finally he was enabled to throw up the coins, by means of an emetic of ipecacuanha, but recovered very slowly from the effects of the poison.(*q*) A

(*l*) Canstaat's Jahresbericht, für 1851, Bd. iv. S. 269.
(*m*) Christison, p. 352.
(*n*) *Vide* Arsenite of Copper.
(*o*) *Vide* Beck.
(*p*) Taylor, Am. ed., p. 112.
(*q*) Canstatt, 1851, Bd. iv. 269.

curious question might well arise in such a case as this. Metallic copper is usually acknowledged to be not poisonous; the poisonous salt, viz., verdigris, was here formed in the stomach by the administration of vinegar. *Query:* Was the poison *administered?*

§ 485. 3d. *Chemical examination.*—The salts of the oxide of copper may be made to yield metallic copper when heated with carbonate of soda upon charcoal before the blowpipe. In this way very minute traces of copper can be detected. The *ferrocyanide of potassium* produces, even in very dilute solutions, a dark purple-red precipitate of ferrocyanide of copper. *Ammonia* precipitates a pale-blue or greenish salt, which, in excess of the reagent, is dissolved, and acquires a beautiful azure-blue color. When the quantity of copper is very small, this color is only perceived by looking through a considerable body of the fluid. *Hydrosulphuric acid* precipitates the sulphuret of copper, of a black or chocolate-brown color. *Iron* will throw down copper from its solutions, in the metallic state. If a bright iron rod be immersed in a neutral or slightly acid solution of a salt of copper, it will soon become coated with copper. So if a solution supposed to contain copper is placed in a platina capsule, and acidulated with sulphuric acid, copper, if present, will be deposited in a metallic form whenever a piece of zinc is brought in contact with the surface of the capsule. This test is peculiarly applicable to liquids derived from organic mixtures.

Tardieu mentions (*r*) a method of chemical analysis in which all the copper present in suspected organic mixtures, can be collected upon a finely polished blade of iron or steel.

§ 486. In *organic mixtures* it may usually be separated as a sulphuret, after previous dilution and filtration. The precipitate should be carefully collected, dried, and then boiled with a little nitric acid to convert the sulphuret into the sulphate. This liquid will acquire a rich blue color, and may then be subjected to the tests above mentioned. These processes will generally suffice for all cases in which the copper is not so excessively minute in quantity that it may become a question

(*r*) p. 537, op. cit.

whether, if discovered, it is not due to some accidental impregnation of the reagents, or of the animal tissues. With reference to the latter point, it may be stated that Orfila has detected traces of copper in the bodies of animals not poisoned by any of its preparations, and Wackenroder has obtained it from human blood. It has also been found in coffee, wheat, and flour, by M. Sarzeau and others.(*s*)

§ 487. According to the calculations of Sarzeau, a man would introduce into his system by ordinary aliments, six and nine-tenths grains of metallic copper in the course of fifty years, not allowing that any of the metal is eliminated by the emunctories. "Though the results announced by chemists and the narration even of their experiments were of such a character as not to be accepted without discussion, they were still allowed entrance upon the rolls of science, and for several years it was found easier to accept rather than to verify them. This tendency soon became general. Along with copper were ranged *normal arsenic*, *normal lead*, *normal mangenese*, etc. The reactionary movement, however, was not long in asserting through the results of several chemists who carefully experimented, putting out of their way every possible source of error, that the animal system did not naturally contain these poisonous products. We do not think a single serious person admits the presence of normal copper in the animal tissues, secretions, or blood.(*t*) M. Roussin records an experiment upon the body of a soldier killed suddenly by a fall from the barracks in Algeria, where he endeavored to determine the presence of normal copper in the organs and other tissues with negative results.(*u*)

Dr. Taylor(*v*) described chronic poisoning by copper in which sometimes the patients die from fever and exhaustion.(*w*)

§ 488. *Fatal dose.*—As cases of acute poisoning are rare, it

(*s*) *Vide* Bley's Archiv für Pharmacie, Oct. 1853; also Christison on Poisons, Am. ed., p. 356.

(*t*) Tardieu, op. cit., p. 543. (*u*) Ibid.

(*v*) On Poisons, p. 520.

(*w*) *Vide* also Böcker, Vergiftungen, 1857, p. 42; Orfila, Toxicologie, i. 912; Casper's Vierteljahrschrift, 1852, i. p. 79; 1855, ii. p. 22; 1856, ii. p. 41; 1857, ii. p. 228; Annales d'Hygiène, 1847, i. 392, and Avril, 1858, p. 328; Dublin Hospital Gazette for Sept. 1854; Lancet, Jan. 1855.

is difficult to determine how small a dose will cause death. The effect of swallowing a single large dose is emetic, and consequently we may suppose that a poisonous dose is often rejected by the stomach. Five drachms of the sulphate have been taken without causing death. (Taylor.) Böcker assigns one or two ounces of verdigris as a fatal dose; but seven drachms have caused the death of an adult. (Taylor.) The greatest danger to life lies in the continued administration of the poison. Sulphate of copper is frequently prescribed by physicians to cause emesis in the dose of five to fifteen grains, and this dose is often repeated till the vomiting is effected.

XVI. *Tartrate of Antimony and Potassa.* (Tartar Emetic.)

§ 489. 1st. *Symptoms.*—The salt is capable of producing violent and alarming symptoms, and occasionally also fatal effects. Its immediate action upon the stomach appears to be irritant, since it produces a burning pain in the stomach, excessive vomiting, and diarrhœa. The large doses which have been tolerated in some febrile affections, such as pneumonia, rheumatism, and mania-à-potu, have thrown some doubt upon its irritant properties, and its speedy rejection from the stomach in other cases defeats, in a measure, both its local and constitutional poisonous effects.

§ 490. The phenomena of acute poisoning by this agent may be thus described: The patient is attacked, within fifteen minutes or a half an hour after ingestion, with incessant retching, præcordial cramps, and burning heat, distension of the epigastrium, watery and frequent stools, dryness of the throat, difficult deglutition, an unpleasant metallic taste in the mouth, and sometimes a copious discharge of saliva. Soon after, the patient complains of distress at the pit of the stomach, and becomes faint or falls into a state of syncope, of agitation, of vertigo or of a sort of drunkenness. The region of the stomach continues painful, and there is heat in the throat and a difficulty in swallowing; vomiting reappears with extreme facility, and the vomited matters are sometimes mixed with blood; the urine is scanty; the extremities become cold, and the skin is covered with a clammy perspiration;

agitation continues, and sleep is broken; the pulse, moreover, is a little quickened, but regular and soft. About the fourth or fifth day there appears upon the extremities and on different parts of the body a vesiculo-pustular eruption like that caused by antimonial ointment. In aggravated cases, the vomitings give place to a persistent hiccough, the stools become involuntary, the urine is suppressed, the coldness at the extremities extends and becomes general, the extremities become cyanotic, delirium and convulsions ensue, and death approaches in a period of time, varying from three to six days. In children, death may occur much earlier, sometimes after a few hours.

In a few rare cases the ingestion of an excessive dose of tartar emetic does not cause vomiting, but may be followed by alvine evacuations, complete prostration, collapse, a few convulsive movements and death in a few hours.

Most often a single excessive dose does not cause death in a person poisoned by this agent. The abundance and suddenness of the vomitings oppose the absorption of the poison, and the reaction, which may occur very early, limits the symptoms of poisoning to their first period; after having vomited for several hours accompanied by alvine evacuations, the symptoms abate, the tongue becomes red, the pulse full, hard, and frequent, and the surface of the body warm. There remains for a short time a headache, epigastric distress, and a feeling of lassitude. The patient recovers his usual health in ten days or a fortnight.

§ 491. *Fatal dose.*—The amount requisite to endanger life is not accurately known, although a case is related by Dr. Beck, in which fifteen grains of tartar emetic killed a child a few weeks old, and in a case reported by Mr. Hartley, ten grains killed a child in a few hours. In several of the fatal cases collected by Dr. Beck, the dose did not exceed a quarter of a grain, but the patients were already weakened by disease. Two grains have proved fatal to an adult.(*x*) Dr. Pereira refers to a case in which death ensued in four days after forty grains had been swallowed. A case is related in which four grains nearly proved fatal. Violent pain in the abdomen, vomiting, and purging took place, and were followed by con-

(*x*) Archives Gén. xxvi. 362.

vulsions: the man became speechless, no pulse could be perceived, and the skin was quite cold; in short, it was supposed he was dead. Stimulating frictions and cataplasms were employed, and he slowly recovered in about fourteen days.(y) An Italian courier died in eleven hours after swallowing, by mistake, *one* drachm of tartar emetic.(z) In a case related by Dr. McCreery, U. S. N., a physician took, through a mistake of the apothecary, half an ounce of tartar emetic. In little more than half an hour he experienced nausea, which was followed by distressing vomiting and purging, with most violent cramps of the legs, and slighter ones of the wrists. Copious draughts of green tea, large doses of tannin, and other appropriate remedies were used, which did not, however, immediately mitigate the symptoms. He remained very much prostrated, but recovered in a few days.(a) In a case observed by Dr. J. T. Gleves, of Tennessee, where a tablespoonful was taken, these symptoms ensued, but reaction was brought about in seven hours. On the third day the fauces were covered with pustules, and on the following day the skin also. The patient recovered.(b) A case is related by Deutsch, in which a woman, who took, by mistake, a scruple of tartar emetic, was brought exceedingly low by its violent action, and died in the course of a year in consequence of its irritant effects upon the intestinal canal.(c) From a tabular view of thirty-seven cases of acute poisoning by tartar emetic, collected by Dr. Taylor,(d) it appears that sixteen proved fatal. Boudet observed local irritant effects upon the fauces twenty-six times out of one hundred and forty-four cases of pneumonia treated with tartar emetic.(e) Difficulty of swallowing and copious perspiration have also been frequently observed. Applied to the skin in

(y) Taylor on Poisons, p. 389. See also two cases in the Union Médicale, 1852, No. 61, p. 245.

(z) Monthly Journ., May, 1850.

(a) Am. Journ. Med. Sci., Jan. 1853, p. 131.

(b) Am. Journ. Med. Sci., vol. xv., from West. Journ. of Med. and Surgery, Jan. 1848.

(c) Canstatt's Jahresbericht für 1851, Bd. iv. p. 270.

(d) Guy's Hospital Reports, 3d ser., iii. 409.

(e) Canstatt, 1853, Bd. v. p. 148.

the form of ointment, it produces a crop of painful pustules, which in weakly subjects may occasionally give rise to ulceration. It may cause nausea and vomiting even when thus used.

§ 491*a*. 2d. *Post-mortem appearances.*—These have been observed in but few cases. In those cases before referred to as having been seen by Mr. Hartley, in which two children, of the ages respectively of five and three years, swallowed each ten grains of tartar emetic, the following appearances were noted. The bodies were examined between four and five days after death. "In that of the boy, there was effusion of serum in the right pleura; the lower lobe of the right lung, posteriorly, was redder than natural, and the peritoneum was injected from recent inflammation. The mucous membrane of the duodenum was inflamed and covered with a whitish-yellow viscid secretion; this was observed throughout the intestinal canal, although the color was of a deeper color in the colon and rectum; there was no ulceration. The peritoneal coat of the stomach was inflamed. The mucous membrane of this organ was much inflamed, especially about the larger curvature and at the cardiac orifice; there was no ulceration. The contents (about two ounces and a half of a dark grumous fluid, having a slightly acid reaction) were very adherent to it; and in one place there was a patch of lymph. The tests used did not indicate the presence of antimony. With regard to other appearances, the tongue was covered with a white fur and appeared soddened; the fauces were not inflamed; the trachea and œsophagus had a natural appearance. On opening the cranium, the dura mater was found very vascular; the longitudinal sinus contained a coagulum of lymph, and but very little blood. The vessels of the surface of the brain were very much injected with dark blood, the whole surface having a deep purple color. Every portion of the brain, when cut, presented many bloody points. The cerebellum and medulla oblongata were also extremely vascular; there was no effusion in the ventricles or at the base of the brain. In the body of the girl, the morbid appearances were similar; there were also patches resembling the eruption of scarlatina on the arms, legs, and neck. The arachnoid membrane was more opaque than usual; and on the

mucous membrane of the stomach, where the inflammation was greatest, were two or three white spots, each about the size of a split pea, which appeared to be the commencement of ulceration."(*f*) The body of a woman, who died in seven hours after taking an unknown quantity of tartar emetic, and was examined thirty-nine hours afterwards, presented no lesions whatever in the stomach and elsewhere.(*g*) But, when life is protracted after the ingestion of the poison, the changes will usually be found like those in the two cases above described. In other words, an aphthous condition of the mouth, fauces, and œsophagus; softening, inflammation, or ulceration of the stomach, and to some extent, also, of the intestines; and generally a dark color and a liquid state of the blood.

§ 492. M. G. Felizet, in an interesting article,(*h*) insists that the principal point of interest in this trial,(*i*) from a scientific point of view, is that of furnishing an example of poisoning by tartar emetic without the appearance of anatomical lesion. Dr. Douglas Maclagan and Littlejohn reported that the body of Mrs. Pritchard presented no appearance of morbid action capable of accounting for death.

§ 493. *Anatomical lesions.*—Most ordinarily, and especially when a single excessive dose has been taken, tartar emetic determines extended and multiform lesions. The œsophagus appears red and presents some ulcerous spots. The stomach and intestines are the seat of a violent inflammation, characterized by a vivid redness with softening of the mucous membrane, upon which are distributed blackened or brownish-red patches formed by the infiltration of blood and by hypertrophy of the follicles. The internal surface of the stomach and small intestine is covered with a blackish, thick, and viscid secretion, sometimes streaked with blood. Occasionally may be

(*f*) Taylor, from Lancet, April 25, 1846, p. 460. See also a case by Mr. Beal, Lancet, Jan. 21, 1854.

(*g*) C. Ellis, Bost. Journ., Dec. 1856, p. 400.

(*h*) *De l'Action toxique du Tartre Stibié*, procès du docteur Pritchard. Archeivs Gén. de Méd., Sept. 1865.

(*i*) *Vide* also Bost. Med. and Surg. Journ., Aug. 10, 1865.

found in the *primæ viæ* and even in the commencement of the small intestine, true pustules filled with pus.

Antimony produces fatty degeneration (*j*) of the liver, and this fact is so well known in the Duchy of Brunswick that the peasants of that district feed their geese upon white oxide of antimony to make them fat and well flavored. The pathological action of this poison upon the lungs is in no way different from that of other poisons of the hyposthenisant group, and consequently not much importance should be attached to the pulmonary lesions occurring in a suspected case of poisoning by this agent.

§ 494. *Chronic poisoning.*—The poisonous effects of tartar emetic when used in small doses for a long time, have been carefully studied by Mayerhoffer(*k*) and by Dr. Taylor. The latter toxicologist renders its probable that the secret poisons which from time to time have produced so many victims, and have rendered so many names infamous in history, were antimonial. The following description of chronic poisoning by tartar emetic is furnished by Dr. Taylor.(*l*)

If tartarized antimony be given in small but increasing doses for a long period, there is uneasiness, nausea, and retching, followed by vomiting; the stools are pasty, and diarrhœa, attended with thin bilious and mucous discharges, gradually sets in; the abdomen at the same time is distended and tense. The voidance of the urine is more frequent and violent. The region of the stomach is tender and painful; that of the liver appears fuller, and is sensitive to the touch. There are griping pains in the bowels, with stiffness and pains in the lower limbs. The warmth of the skin is at first increased; there is itching or irritation with alternation of heat and cold. The appetite is suppressed, and when any substance is eaten there is nausea, with an immediate disposition to vomit. A roughness or rawness is perceived in the throat, with painful swallowing; the tongue is covered with a dirty mucus, and the mouth is clammy. The head feels full and heavy. At a still later period the

(*j*) *De la steatose*, Thèse du concours d'aggregation de la Faculté de Medicine de Paris. Blachez, 1866, p. 38.

(*k*) Beiträge zur Heilkunde, ii. 372.

(*l*) Guy's Hosp. Reports, 3d ser. iii. 388.

feces contain much mucus, and are frequently strongly colored with bile. The blood gradually loses its fibrin, and becomes almost liquid, and dark-colored. It contains an increased proportion of fluid and saline matters, with traces of antimony. If the use of the substance be longer continued, there is slowness, with a loss of power in the heart and pulse; the breathing is difficult, the complexion dusky; there is complete depression of the vital powers, with great debility and emaciation; the legs become heavy and stiff, as if paralyzed, and death may follow as a result of the noxious impression produced on the more important organs of the body. Small doses act more powerfully when dissolved, than when administered in the form of powder. In addition to the above symptoms, the vomiting, from which the patient suffers, is either attended or followed by the distension of the abdomen, and flatulence; liquid bilious motions, with colicky pains, paleness and sunken appearance of the countenance; cold perspiration, giddiness, great prostration of strength, incapability on the part of the patient of raising himself to the erect position, disposition to rest and sleep, loss of strength, fulness and frequency of the pulse, faintings, in many cases a feeling of coldness, accompanied with a heat or flushing of some parts of the body, *e. g.*, the face. If there is a recovery from this condition, pain in the stomach is felt for a long time afterwards, and inflammation of the stomach to a greater or less degree is set up. After the vomiting, there remains, for a longer or shorter period, an unwillingness to take food, and nausea in partaking of it. Among other effects, the perspiration and the urinary secretion are observed to be greatly increased.

If the use of tartarized antimony be continued in increasing doses when the poison has been already carried into the blood, the secretory organs are more strongly stimulated, and absorption as well as secretion, especially of the serous liquids, is greatly augmented.

If vomiting does not take place after large doses, the following symptoms of poisoning are observed: metallic taste, nausea, retching, and bilious vomiting; burning pain in the throat, gullet, and stomach; spasms of the jaw and neck; pain and flatulent distension of the abdomen, with frequent

watery motions; coldness, pallor, and clamminess of the skin, sometimes great heat of skin; difficult breathing, painful sobbing, giddiness, stupefaction, loss of consciousness, delirium, spasms of the arms and legs, with complete prostration of strength. Death appears to result from the impression produced on the nerves of motion, as well as on the nerves of the lungs and heart; leading either to asphyxia or paralysis.

§ 495. Attention has been already called (*m*) in this work to the liability of confusing the symptoms of poisoning by tartar emetic with those of a disease called cerebro-spinal meningitis, and in the trial of Mrs. Wharton for poisoning General Ketchum, it has been shown that this is a difficult question to decide. It must, however, be remembered that some of the medical men summoned as experts in that case were not competent to give technical testimony, and may have been prejudiced, either from a spirit of rivalry, or by a premature conviction that the prisoner was guilty of the charge of poisoning. The testimony of some of the witnesses was to the effect that the symptoms preceding the death of General Ketchum could not be attributed to any known disease, and yet they seemed to resemble those of the above-named malady, as has been clearly exposed in an article by Dr. Reese, in the *Amer. Journ. of Med. Sciences*, before referred to.

§ 496. 3d. *Chemical examination.*—It is proper to bear in mind, as Dr. Taylor remarks, that antimony given in a large dose, or repeatedly in small doses, is rapidly absorbed and eliminated chiefly by the urine. It is at the same time deposited in a greater or less quantity in the tissues and organs. Under recent administration, if in sufficient quantity, it may be found in the stomach and bowels, and little or none may be present in the liver. After a variable time it disappears from the stomach and bowels, although it may be present in the feces, while the liver, kidneys, and spleen may contain it in large, and the other organs in small quantity. In certain diseased states of the system, the complete elimination of the metal may require a period of twenty-five or thirty days or longer; but in a healthy subject, to whom only ordinary

(*m*) *Vide* § 338 (*g*), p. 299.

medicinal doses have been given, the antimony is quickly expelled.

The double tartrate of antimony and potassa (tartar emetic) is readily soluble in water, even when it contains uncombined cream of tartar.

1. A crystal or two dropped into a solution of *hydrosulphuric acid* will be covered with an orange-colored deposit of the ter-sulphide of antimony. This is readily soluble in potassa and in the sulphide of ammonium, sparingly so in ammonia, and insoluble in bicarbonate of ammonia.

2. Exposed to the reducing flame of the blowpipe with carbonate of soda, white incrustations and globules of antimony are obtained, known by the needle-shaped crystals with which they are beset, their metallic brilliancy and brittleness.

3. *Nitric acid* throws down from the solution a white precipitate, which is soluble in an excess of the reagent, and also in tartaric acid. It is also soluble in a solution of potassa.

4. Ferrocyanide of potassium causes no precipitate.

5. If the solution be introduced into Marsh's apparatus and the gas evolved and inflamed, spots may be obtained upon porcelain which are blacker and less brilliant than those of arsenic, and which do not undergo any change by dropping upon them a concentrated alkaline solution of hypochlorite of soda. Nitric acid converts this sublimate into the white oxide of antimony; a drop of nitro-muriatic acid dissolves it completely, and the solution, carefully freed by evaporation from the excess of acid, gives with hydrosulphuric acid an orange-red precipitate. With sulphide of ammonium the precipitate is of an orange color, and is soluble in an excess of the reagent. A metallic antimonial ring may also be obtained by applying the flame of a spirit-lamp to the tube while the stream of antimoniuretted hydrogen gas is passing through it. The metallic globules of antimony, recognizable by a lens, may be obtained from the ring by a sufficient increase of heat. No odor of garlic is perceived in this operation. All vegetable substances containing tannin decompose the salts of antimony.

§ 497. *Detection of antimony in organic liquids.*—If an examination of the *tissues* is required for the purpose of detecting

absorbed antimony, the liver should be selected as the organ most likely to contain it.

The destruction of the organic matters should be accomplished by the same means employed in arsenic, either by sulphuric acid, or by hydrochloric acid and chlorate of potash. The sulphuric carbon thus obtained is treated with nitro-muriatic acid (aqua regia); after this has been boiled to dryness, the residue is digested by water containing five to ten per cent. of tartaric acid; this is then boiled, filtered, and washed. Through the solution thus obtained, or the product of the destruction by chlorate of potash, a current of sulphuretted hydrogen gas is passed; this must then be allowed to stand until all the antimony has been precipitated in the form of sulphuret of antimony, which can afterwards be redissolved in aqua regia, and be submitted to the different tests for antimony, or to Marsh's apparatus for the detection of antimony and arsenic. (Of course, the reagents must be tested, as in the case of arsenic, for their purity.)

Introduce the liquid into a horizontal tube connected with a vessel in which hydrogen is generated. Transmit the gas freely till all risk of an explosion is passed, and apply the flame of a spirit-lamp to the part of the tube containing the precipitate. The metal is reduced, remaining in the place of the sulphuret if the stream of gas is slow, but undergoing a spurious sublimation if it is rapid, and collecting on the sides of the tube in the form of detached crystals, or of a crystalline crust. The metal is apt to be concealed by the presence of animal or vegetable matter. In this case it should be heated in an open tube, when it oxidizes and sublimes as a glittering white powder, which, unlike arsenic, is not crystalline; or the antimony may be dissolved by nitric acid, the resulting solution neutralized, and the orange-red sulphuret be again thrown down by a stream of sulphuretted hydrogen.(*n*) Or the sulphuret, when dried, may be dissolved by boiling hydrochloric acid. A dense yellowish-white precipitate of oxichloride of antimony falls down, on adding this solution to a large quantity of water. Although a white precipitate is produced also

(*n*) Guy's For. Med., p. 499.

by the salts of bismuth when added to water, the color produced in the liquid by sulphuretted hydrogen at once will distinguish the two bases; bismuth yields a black, and antimony an orange-red precipitate.

M. Lassaigne states that in certain cases the presence of antimony contained in organized matter is sometimes very faintly, or not at all, revealed by Marsh's apparatus.(o) He has proved this to be the case by subjecting the residue to a new test. His plan of procedure is the following: fifty grammes of the suspected liver were burned in a new porcelain crucible, and the resulting carbon calcined and kept for several hours at a cherry-red heat. The ash, collected and reduced to a fine powder, was successively treated by weak nitric acid, and afterwards by pure hydrochloric acid. The last solution, diluted with a weak solution of tartaric acid, was filtered and brought into contact with three times its volume of hydrosulphuric acid. This reagent immediately rendered the liquid turbid, and threw down an orange-yellowish flaky precipitate of *hydrated sulphuret of antimony.* Its color and volume compared with those produced in a standard solution of tartar emetic, rendered it possible to estimate the proportion of this salt contained in the hepatic tissue submitted to examination. Antimony may be separated from liquid organic mixtures by Reinsch's process also, viz., by boiling with muriatic acid and water in the presence of copper. This metal acquires a bluish-gray color from the disposition of metallic antimony.

§ 498. The antimonial spots are very brilliant and are less volatile than those furnished by arsenic; they disappear on the addition of nitric acid; but when, after being dried by evaporation, a drop of a solution of nitrate of silver is added, the brick-red precipitate which characterizes the arsenite of silver is absent. These spots dried with a solution of a hypochlorite (hypochlorite of lime one part, and water 19 parts) do not disappear, but preserve their brilliancy. Arsenical spots treated in the same way are immediately dissipated. That portion of the tube which incloses the metallic ring is detached and introduced into a porcelain capsule containing a few drops of

(o) Annales d'Hygiène, Jan. 1859, p. 192.

pure nitric acid. After the solution has been effected, the tube is removed by means of a platinum wire and washed with a few drops of water. The acid liquid must be completely evaporated to dryness, and then a few drops of ammonia-water added until the liquid becomes alkaline. After this last solution has been evaporated over a water-bath to dryness, two drops of a *neutral* solution of nitrate of silver are turned into the capsule. If the suspected spot is due to antimony, no coloration of the residuum occurs, but if it is arsenic a brick-red precipitate of arsenite of silver is produced, the latter being very soluble in ammonia and nitric acid. (Tardieu.) Frequently, when a physician has been called to a suspected case of poisoning, he may give a powerful emetic. The substances vomited should consequently be reserved for chemical analysis.

§ 499. In ordinary cases of medico-legal research, especially when the expert has had no intimation of the suspected poison to guide him, he destroys the organic matters by the addition of concentrated sulphuric acid. The carbonized material resulting from this process should be treated with nitric acid and then carefully washed several times with distilled water; thus the metallic oxides in the condition of soluble salts, nitrates, and arsenic itself in the state of arsenic acid are dissolved. But the antimony remains wholly or partially in an insoluble compound within the carbonized residuum. This residue should never be thrown away, but, if the analysis does not afford a satisfactory and accurate result, it should be digested with water sharpened by tartaric acid. The resulting liquid should be, after its filtration, directly introduced into Marsh's apparatus.

§ 500. The following table(*p*) may be convenient to determine at a glance the different properties of arsenic and antimony:—

(*p*) Médecine légale, par Briand et Claudé, Paris, 1869, p. 654.

ARSENIC.	ANTIMONY.
Volatile, easily displaced in a current of hydrogen.	Less volatile, melting into minute globules.
Disappears in presence of nitric acid. The solution, evaporated to dryness, deposits by a neutral solution of nitrate of silver a brick-red precipitate of arsenite of silver.	Gives no reaction with nitrate of silver.
Is dissolved by the addition of an alkaline hypochlorite.	Preserves its metallic lustre, if the layer is rather thick.
The metallic ring heated in a current of sulphuretted hydrogen gives a yellow sulphuret of arsenic, soluble in ammonia, unaltered by hydrochloric gas.	The ring gives a black or yellow sulphite, being transformed in volatile chloride by hydrochloric gas.
The gas set free in Marsh's apparatus reduces the nitrate of silver and gives a soluble arsenious acid.	The gas reduces nitrate of silver, and the antimony is wholly precipitated.

§ 501. A difficulty is suggested by the combined administration of arsenic and antimony. M. Bouis states that the best method for separating these two poisons is the following, based on the action of arsenuretted hydrogen, and of antimoniated hydrogen upon a solution of nitrate of silver:—

Instead of forming a metallic ring in Marsh's apparatus, the gas is passed into an *éprouvette* containing a solution of nitrate of silver; the arsenuretted hydrogen is transformed into arsenious acid; the antimoniated hydrogen gives the insoluble antimonide of silver; the two gases produce at the same time reduced silver. When all the suspected matter has been introduced into the apparatus, and the gas has been disengaged long enough, the black precipitate of silver and the antimonide of silver are collected on a filter and thoroughly washed. In the filtered liquid the excess of silver is precipitated by hydrochloric acid in the form of white chloride of silver; which is again filtered and the arsenic is precipitated from the clear solution by sulphuretted hydrogen. As for the black residue which remains upon the filter, that can be digested by aqua regia, and then diluted with a little water; chloride of silver is deposited, and in the filtered liquid the chloride of antimony is left. It would be better, instead of treating the residue

with aqua regia, to boil it with a concentrated solution of tartaric acid, which will dissolve the antimony without attacking the silver.

The spleen, kidneys, and urine should likewise be examined for antimony.

§ 502. It is evident that the presence of antimony, either in the stomach or absorbed in the other organs, may be due to the proper medicinal administration of the salt. The forms under which it is given, and the occasions on which it is prescribed, are numerous, and it is not unfrequently administered in cases of poisoning with other substances, without a thought of the complications it may, in case of a death, place in the way of the chemist. Hence, unless the possibility of its introduction into the system under any of these circumstances be fully excluded, the object of the medico-legal inquiry may be entirely frustrated.

§ 503. 4th. *Chloride of antimony.* (Butter of antimony.)—This substance is highly corrosive in its action. The following case will be sufficient to illustrate its effects. "An army surgeon swallowed, for the purpose of suicide, from two to three ounces, by measure, of chloride of antimony. About an hour afterwards he was seen by Mr. Mann. There was entire prostration of strength, with coldness of the skin and incessant attempts to vomit. The most excruciating griping pains were felt in the abdomen, and there was a frequent desire to evacuate the bowels, but nothing was passed. In the course of a few hours reaction took place, the pain subsided, and the pulse rose to 120. There was now a strong disposition to sleep, so that he appeared as if laboring under the effects of a narcotic poison. In this state he continued until he died, ten hours and a half after he had swallowed the poison. On inspection, the interior of the alimentary canal, from the mouth downwards to the jejunum, presented a black appearance, as if the parts had peen charred. In general, there was no mucous membrane remaining either on the stomach or elsewhere, only a flocculent substance, which could be easily scraped off with the back of a scalpel, leaving the submucous tissues and the peritoneal coat. All these parts were so soft that they could

be easily torn with the fingers.(q) The symptoms have been similar in some cases which recovered. Poisoning with this substance is, however, very rare, and mostly happens from mistake, or it is taken with suicidal intentions. The tests are the same as for tartar emetic.

XVII. *Salts of Zinc.*

§ 504. 1st. *Oxide of zinc* has been of late years used as a substitute for white lead, with the view of avoiding the dangerous effects of the latter on the workmen. It has been supposed to be innocuous, and this idea appeared to be confirmed by some experiments made by M. Flandin. He rubbed animals over with ointments of oxide of zinc, of carbonate of lead, and sulphate of lead; the last two were found always to produce poisonous effects, but the animals rubbed with the ointment of oxide of zinc continued to enjoy their usual health. A case has, however, been recorded by Dr. Bouvier, of the Hopital Beaujon, at Paris, in which a laborer who had been employed for fifteen days in barrelling oxide of zinc, and who in other ways had handled this substance, and breathed an atmosphere loaded with its powder, was attacked with vomiting, colic, and constipation. These symptoms persisted, and increased in intensity so much that he rolled on the floor in agony. The vomited matters were bilious, he rejected his food almost immediately after swallowing it, and he had been constipated for five days. From the whole history of the case, it was considered to be one of genuine zinc colic. He was cured by the remedies usually employed for painter's colic. The particles adhering to his body were examined, and found to consist of oxide of zinc.(r) Ladouzy and Maumené have seen workmen, who were obliged to inhale an atmosphere loaded with particles of oxide of zinc, affected with inflammation of the mouth and throat, salivation, general distress, colic, and diarrhœa, or obstinate constipation.(s)

Cases of zinc-poisoning, arising from the inhalation of the

(q) Taylor on Poisons, Am. ed., p. 397.
(r) Am. Journ. Med. Sci., Oct. 1850, from the Comptes Rendus.
(s) Briand, Méd. Lég., 6ème éd., p. 433.

oxide of zinc, have also been observed among the workmen engaged in twisting and beating the iron wires galvanized with zinc used for securing champagne corks. Four had symptoms of general depression, with sore throat, swelling and ulceration of the tonsils, salivation, fetid breath, colic, and diarrhœa. In one case there was colic and obstinate constipation. These symptoms subsided readily on abandoning the occupation, and did not return when the work-people resumed their work, with wires better prepared, and free from loose oxide or carbonate of zinc.(*t*) M. Blandet has described as effects of breathing the vapors of zinc fused at the temperature required to melt copper, chilliness, trembling, headache, fainting, vomiting, buzzing in the ears, contusive muscular pains, etc.(*u*)

§ 505. With regard to zinc as a poison, the best authorities are in disagreement. Briand and Chaudé, in their excellent work, declare that metallic zinc is not poisonous.(*u*[1]) If accidents have occurred to workmen who work with this metal, they affirm that these must be due to the presence of arsenic in the zinc. Dr. Taylor(*v*) mentions the case of an epileptic who took in the course of seven months one pound, having taken in one day seventy grains. Tardieu does not mention zinc as a poison in his work on toxicology. Neither the oxide nor the sulphate of zinc can be regarded as powerful irritants. There is no case, we believe, on record where this agent has been proved incontestably to have caused death.

§ 506. 2d. *Sulphate of zinc.*—The prompt emetic action of sulphate of zinc (white vitriol) is the cause of its seldom producing serious effects. The dose usually administered with a view to its emetic operation is from fifteen grains to half a drachm, and unpleasant results have seldom been witnessed from this amount. Dr. Babington once gave thirty-six grains three times a day, for several weeks, without any sickness or other untoward effect being produced; but cases in which the

(*t*) Am. Journ. Med. Sci., Oct. 1850, from Monthly Journ., Aug. 1850.
(*u*) Journ. de Méd., 1845, p. 76. (*u*[1]) p. 672.
(*v*) Medical Jurisprudence, p. 255.

stomach would tolerate such doses as these must be very rare.(*w*)

§ 507. Christison mentions several cases in which the salts of zinc were supposed to have been the cause of death; yet some of these seemed to him doubtful. "Even in large doses it can hardly be accounted poisonous, as it merely gives rise to vomiting and slight diarrhœa; and that an adulteration to such an amount would always betray itself by its strong disagreeable taste."(*x*) The best-marked cases are, however, those which have been reported as occurring at Pavia. The first case occurred in the person of a strong woman, who took, by mistake for Epsom salts, a solution of an ounce and a half of sulphate of zinc. She instantly vomited, and then became affected with almost incessant retching and purging for half an hour, which continued afterwards, at short intervals, for three hours, and then gradually diminished. The pulse was frequent and small, and extreme prostration existed, accompanied with distressing restlessness and anxiety; the temperature of the skin was diminished; great pain in the abdomen, limbs, etc., existed, as well as a sense of burning in the throat and stomach. She died thirteen and a half hours after taking the poison, retaining her intellectual faculties to the last. On examination, forty hours after death, the following were the chief appearances observed: great lividity of the skin, congestion of the brain and its membranes, congestion of the lungs, flaccidity of the heart, the inner surface of the stomach covered with a yellowish pultaceous matter, on the removal of which an uniform yellow ochrous color was observed, except towards the great curvature, where it became reddish; a gelatiniform softening (*ramollissement*) of the mucous membrane prevailed, exposing in some parts the submucous cellular tissue. The small intestines were somewhat injected, and contained yellowish matters. In the *second* case a similar dose was taken, followed by nearly the same symptoms, but the patient recovered. In the *third* case a quarter of an ounce was taken, which produced the same symptoms of irritant poisoning,

(*w*) Guy's Hosp. Rep., vol. xii. p. 17.

(*x*) Christison, op. cit., p. 450; and Orfila's Toxicologie, i. 567.

ending in recovery. In the *fourth* case, of which little account is furnished, but which proved fatal, it is stated that "two drachms of sulphate of zinc were detected in the liver and blood, the fluids of the alimentary canal furnishing but little."(*y*)

One case, in which the sulphate of zinc was supposed to have been given with criminal intentions, became the subject of judicial inquiry in France. An old man died somewhat suddenly, having suffered from severe pain and great heat in the chest and abdomen, with violent vomiting and purging. He was not seen by a physician. On inspection, the stomach and bowels were found highly inflamed, and sulphate of zinc was found in the contents of the stomach, and detected in the tissues. The body of a woman who had died two months previously, was also disinterred, and sulphate of zinc found in the viscera.(*z*) Violent enteritis was also observed in a case reported by Krauss.(*a*) Dr. Gibb has reported the case of a lady who took by mistake about sixty-seven grains of sulphate of zinc in solution. She recovered, and her more serious symptoms were probably owing to two grains of tartar emetic ignorantly administered to her.(*b*) A case has been recorded by Dr. Ogle, of a drunkard who attempted to commit suicide by cutting his throat. It was believed, but upon no direct evidence, that he had been in the habit of swallowing a strong lotion which he was using for inflamed eyes. The immediate cause of death was not determined, but the reporter states that an examination of the body revealed the presence of sulphate of zinc in the stomach, a white and shrivelled appearance of the mouth and fauces, a condensed, indurated, and tripe-like appearance of the lining membrane of the stomach, and to some degree of the small intestine, and an unusually contracted state of the colon and rectum.(*c*) Two more recent cases are recorded by Dr. Niemann.(*d*) In the first, a sickly man died with violent gastric pains and vomiting, after a dose administered to him by his wife, and sulphate of zinc was found

(*y*) Brit. and For. Med.-Chir. Rev., April, 1849.
(*z*) Journ. de Chimie Méd., 1845, p. 529.
(*a*) Canstatt's Jahresbericht, 1853. (*b*) Lancet, May, 1850, p. 540.
(*c*) Lancet, Aug. 1859, p. 210. (*d*) Henke's Zeitschrift, lxxviii. 219.

upon chemical analysis in the contents of the stomach. The second case was one of suicide. In neither was the quantity of the poison determined.

It is extremely probable that most of the recorded cases of poisoning by zinc salts could be explained by the feeble condition of the person reputed to have been poisoned or by the known impurities of the commercial salts sold under their name, as the best toxicologists, even Christison and Orfila, appear to have had doubts of their poisonous nature.

§ 508. *Chemical examination.*—Sulphate of zinc is a white, crystalline substance, bearing considerable resemblance to sulphate of magnesia, readily soluble in water, and having a disagreeable styptic taste. From its solution, if pure, the oxide is thrown down by the *caustic alkalies*, in the form of a white hydrate, which is easily soluble in an excess of the precipitant. The *sulphide of ammonium* gives a white milky precipitate, and also sulphuretted hydrogen, provided there is no free acid in the solution. *Carbonate of ammonia* precipitates carbonate of zinc, also white, which is readily dissolved in an excess of the precipitant. *Ferrocyanide of potassium* also causes a white precipitate. The *sulphide of ammonium* is the most characteristic and unobjectionable of these tests, for zinc is the only metal, with the exception of aluminum, the salts of which are thrown down white by it.(*e*) Having discovered the base, the presence of sulphuric acid in the combination may be easily detected, by testing with chloride of barium.

The following is the process recommended by Christison, for the detection of sulphate of zinc in *organic mixtures*. The mixture having been strained through gauze, it is acidulated with acetic acid, and filtered through paper. The acetic acid dissolves any oxide of zinc that may have been thrown down in union with animal matter. The filtered fluid is then to be evaporated to a convenient extent, and treated, when cool, with sulphuretted hydrogen gas; upon which, a grayish or white milkiness, or precipitate, will be formed. The excess of gas must now be expelled by boiling, and the precipitate washed

(*e*) In the case of alumina, the precipitate is soluble by caustic potash; and in that of zinc by an excess of ammonia.

by the process of subsidence and effusion, and collected on a filter. It is then to be dried, and heated to redness in a tube. When it has cooled, it is to be acted on by strong nitric acid, which dissolves the zinc, and leaves the sulphur. The nitrous solution should next be diluted and neutralized with carbonate of ammonia;(*f*) after which, the liquid tests, formerly mentioned, will act characteristically. The effect of carbonate of ammonia and that of heat on the carbonate of zinc, which is thrown down, ought to be particularly relied on.

§ 509. *Chloride of zinc.*—Several cases of poisoning by a solution of this salt, known by the name of "Sir Wm. Burnett's disinfecting fluid," have occurred in England and Canada. This is probably due to the fact that it contains so much hydrochloric acid that it produces a highly caustic action upon the mucous surfaces.

The symptoms observed have been violent epigastric distress, followed by vomiting, and attended with burning heat in the mouth and throat. In a case reported by Mr. Letheby, where a child fifteen months old was poisoned by it, prostration was extreme, and the child died comatose in ten hours. The body was examined twenty-two hours after death. The lips, mucous membrane of the mouth, fauces, and œsophagus, were white and opaque. The stomach felt hard and leathery, and contained a liquid like curds and whey. Its inner surface was corrugated, opaque, and tinged of a dark leaden hue; this appearance ceased abruptly at the pylorus. On digesting the stomach in an ounce of distilled water, the liquid obtained gave white precipitates with prussiate of potash, carbonate of soda, and sulphuretted hydrogen and acid nitrate of silver, no precipitate being obtained on the addition of a soluble salt of baryta. The presence of chloride of zinc was thus demonstrated. The author concludes, from some experiments, that the chloride of zinc is distinguished from the other salts of the metal by its quick and firm coagulating action on liquid albumen and on the delicate tissues of the body, and that its toxicological action is twofold: first, as an irritant and caustic; and, second, by a specific constitutional impression upon the

(*f*) Carbonate of soda is more soluble.

nerves.(*g*) In the cases reported by Dr. Stratton, although death appeared imminent, the patients were saved by timely medical aid.(*h*)

Since the first edition of this work several fatal cases have occurred, some of which are referred to by Dr. Webb, in the account published by him of a case in which recovery took place after an ounce of the liquid had been swallowed.(*i*) A like quantity in another case, and in still another a pint of the solution, were fatal. The symptoms observed in nearly all of the cases were intense burning pain in the epigastrium, extending afterwards to the rest of the abdomen; persistent vomiting first of the contents of the stomach and then of blood, with urgent thirst; a cold and pale surface, a failing and gradually extinct pulse, dilated pupils, cramps in the extremities, a husky and whispering voice, and death without a struggle or previous loss of consciousness. After death the body has been found unusually livid; the stomach extremely vascular and purplish, lined with tenacious mucus, and its mucous membrane more or less softened, corroded, and disintegrated in the cardiac half of the organ. The pyloric orifice is constricted, and corrugated, and its lining membrane may be dense and tough, and in color and consistence resemble wash-leather. The duodenum partakes of the discoloration and softening observed in the stomach, and the same changes exist in some degree in the jejunum. The œsophagus is lined with tenacious mucus, or with patches of false membrane. It is remarkable that the mouth is seldom acted upon by the poison.(*j*)

Death may result after a considerable period from alterations produced in the stomach by the poison. A woman who had taken an ounce of Burnett's fluid, recovered from its immediate effects, but died in ten weeks from the inability of the stomach to retain food. On examination, the stomach near the pylorus was found so contracted as scarcely to admit a probe of the size of a crow's quill.(*k*)

(*g*) Lancet, July 6, 1850. (*h*) Med. Exam., Feb. 1849.

(*i*) Times and Gaz., July, 1856, p. 59.

(*j*) For cases, see Lancet, Sept. 1857, p. 271; Beale's Archives, 1858, No. iii. p. 194.

(*k*) Markham, Times and Gaz., June, 1858, p. 595.

XVIII. *Tin.*

§ 510. *Chloride of tin.*—This preparation needs little notice: it is an irritant poison, but has seldom given rise to accidents. An old man dried some wet cooking salt in a tin dish upon a stove, and then ate some meat and bread with which he had wiped the dish. He was seized with chilliness, violent pain in the stomach, and the abdomen became swollen and tender upon pressure. A febrile condition was soon set up; but the most striking symptom was salivation, with extreme fetor of the breath, and a grayish discoloration of the gums. They, as well as the tongue and inside of the cheeks, became covered with ulcers. By an antiphlogistic treatment, and gargles of chloride of lime, he was restored in a few days.(*l*)

XIX. *Silver. Gold. Platinum.*

§ 511. *Nitrate of silver.* (Lunar caustic.)—The appearance of this caustic is well known. Poisoning by it is not, however, of frequent occurrence. A patient at the Hôpital St. Louis, in Paris, recovered, after having swallowed an ounce in solution. The nitrate of silver was neutralized by the administration of common salt.(*m*) In a case reported by Krahmer a like quantity produced insensibility to tactile impressions, loss of consciousness, and convulsions. By the sixth day the patient had recovered.(*n*) The nature of the poison can be readily detected by the black color which it communicates to organic matter.

The *terchloride of gold* is also a highly irritant poison, acting very much like corrosive sublimate. Cullerier, the nephew, has seen one-fifteenth of a grain excite, at the second dose, gastric irritation, dryness of the tongue, redness of the throat, colic, and diarrhœa.(*o*)

The *bichloride of platinum* is a powerful caustic poison. It is

(*l*) Memel. Deutsche. Klinik., No. xli. 1851.
(*m*) Am. Journ., 1840, p 239.
(*n*) Canstatt's Jahresbericht, 1846, p. 247.
(*o*) Pereira, Mat. Med.

sometimes used, in medical practice, for the treatment of secondary syphilis.

XX. *Iron.*

§ 512. 1st. *Sulphate of iron.* (Copperas; Green vitriol.) (1) *Symptoms.*—A case of supposed criminal poisoning with this substance is related by Dr. Christison. A girl, four years of age, and previously in good health, was attacked with violent vomiting and purging immediately after breakfasting on porridge, and died in the course of the afternoon of the same day. The porridge had a blue color, and it was proved that a woman in the house had purchased both this salt and the sulphate of copper. The body being disinterred, four months after death, the stomach was found soft, gelatinous, and of an uniform intense black color through the whole thickness of its parietes, and the entire alimentary canal lined with a thick layer of jet black mucus "from the pharynx down to the very anus." There was no evidence found of the presence of copper, but abundant proof was obtained of the presence of iron both in the textures of the stomach and the black mucus which lined it.(*p*) More recently, a case somewhat similar has been observed by Orfila. It was that of a child, aged fifteen months, who died after purging and vomiting a black fluid. On opening the body, ten days after burial, the stomach was filled with a greenish fluid, and the vessels of the lungs and brain were gorged with black blood. M. Orfila detected sulphate of iron, in notable quantities, in the portions of the abdominal contents forwarded to him.

(2) *Chemical analysis.*—It should not be forgotten, in making a chemical examination of the viscera, in cases of supposed poisoning with the salts of iron, that iron is a normal constituent of the body. Orfila says, that when these, or the salts of copper or lead, exist in the alimentary canal, as a consequence of poisoning, we have only to treat the canal by means of very dilute muriatic or acetic acid, at a moderate heat; these acids dissolving the metallic substances sought for, without attacking any portion of those metals that form part of

(*p*) Ibid., p. 393.

the organization. To obtain these last, we must treat the viscera by more energetic agents, or by incineration.(*q*) The crystals of sulphate of iron are of a bluish-green color, have a styptic taste, and are readily soluble in water. The base may be detected by the ferrocyanide of potassium (producing a greenish-blue precipitate), and the acid by the chloride of barium.

§ 513. 2d. *Chloride* (Muriate) *of iron.*—The medicinal tincture of this salt of iron has frequently given rise to serious and fatal accidents. The symptoms produced by it are very much like those of the corrosive acids, viz., heat, dryness, and swelling of the throat, with a burning pain in the stomach and in the course of the œsophagus, vomiting of blood, and inky evacuations. Its corrosive properties seem to be due to the presence in it of free hydrochloric acid. Dr. Christison relates a case, in which death occurred in about six weeks after an ounce and a half of the tincture had been swallowed. A case of recovery, after three ounces of the concentrated tincture had been swallowed, is reported by Sir William Murray.(*r*)

A gentleman, aged seventy-two, swallowed three ounces of it by mistake. He was found "tossing about in the utmost consternation and agony; his tongue was swelled, and protruded from the mouth; its skin was parched and peeling off it, while ropy mucus flowed from the mouth and nose; the eyes seemed starting from their sockets; the respiration was noisy and laborious, and suffocation seemed to be impending. During this time his hand was riveted to the region of the stomach, as the principal seat of pain; the palate and the interior of the mouth were burned, and presented a parboiled appearance." The acid was first neutralized by an alkaline mixture, and this treatment was followed by demulcents and laxatives. The gentleman rapidly recovered.(*s*) Several other cases of recovery from large doses are recorded, which it is not necessary to particularize.

(*q*) Am. Journ. Med. Sci., Jan. 1853, p. 259.
(*r*) Ibid., July, 1849.
(*s*) Sir Wm. Murray, Dub. Med. Press, Feb. 1849.

Tests.—The iron may be detected by the blue precipitate with *ferrocyanide* of potassium, and the hydrochloric acid by the nitrate of silver.

XXI. *Bismuth.*

§ 514. *Subnitrate of bismuth.*—A man subject to water-brash took two drachms of this preparation by mistake. He was immediately attacked with burning in the throat, vomiting, purging, cramps, and coldness of the limbs, his pulse became intermittent, and he had a constant metallic and nauseous taste. On the third day he had hiccough, laborious breathing, and swelling of the hands and face, and suppression of urine was then discovered to have existed from the first. On the fourth day, swelling and tension of the abdomen were added to the pre-existing symptoms; on the fifth day, salivation; on the sixth, delirium; on the seventh, swelling of the tongue and enormous enlargement of the abdomen; and, on the ninth, he expired. The tonsils, uvula, pharynx, and epiglottis were gangrenous, and inflammatory redness, with spots of gangrene, existed throughout the whole intestinal canal.(*t*) Sobernheim explains the poisonous effects in the above case and in one observed by himself, by supposing that the patients' stomachs contained bitartrate of potassa, enough to convert the subnitrate into an acid nitrate of bismuth, which is stated to be an active irritant.(*u*) Certain it is that pure subnitrate of bismuth is constantly given in unmeasured doses without any toxical effect whatever. It has been found that this preparation of bismuth is often so carelessly made, that the arsenic which is commonly found in bismuth has often not been previously excluded by the operation of roasting. M. Cornut recommends that it should be tested before being dispensed for medicinal purposes. Moisten half a drachm of the tri-nitrate of bismuth with a sufficient quantity of *pure* sulphuric acid, evaporate to dryness in a small porcelain capsule, wash the residue with a little distilled water, filter, and put into a Marsh's apparatus.(*v*)

(*t*) Christison, Treatise on Poisons, 2d ed., Edinburgh, p. 444.
(*u*) Arzneimittellehre, 6te Aufl. p. 268.
(*v*) Association Med. Journ., June 17, 1853.

above and one other (*w*) are the only recorded cases of ing by this drug, and it is exceedingly doubtful whether fects may not be attributed to impurities in the agent or ie other cause. The first case was reported in 1831, and then there has been but one death attributed to the use s drug. Many years ago arsenic was not an infrequent nation with bismuth in the form of arseniate of bismuth, ; to its incomplete preparation; but now, by the process mended in the U. S. Pharmacopœia, the bismuth is free arsenic. As bismuth is quite freely used in the treat- of diarrhœa and other intestinal irritations, in the dose m two to six drachms, without any apparent danger to can hardly be called a corrosive poison. In fact, Head-) asserts that the subcarbonate of bismuth is not more absorbed in the alimentary canal than charcoal.

XXII. *Chromic Acid.*

5. *Bichromate of potash.*—This salt, being extensively a dyeing, has given rise, in several instances, to acci- poisoning. Locally applied, its action is irritant, caus- the workmen who make use of it, troublesome sores and ions upon the hands. Taken in poisonous doses in- y, its action is highly irritant also, and death has taken rom it, with the symptoms usually attending the action tant poisons. Mr. Wilson, however, relates a case in death was caused by it, without any vomiting or purg- ving occurred.(*y*) Several fatal cases have occurred in nore. The following was communicated by Dr. Baer, to sor Ducatel: A laborer, aged 35, on attempting to draw m a refiner a solution, in the effort to exhaust the si- by suction, received a small quantity of the solution into outh. His first impression was, that he had spit it out; ly a few minutes elapsed before he was seized with great n the throat and stomach, and violent vomiting of blood nucus. The vomiting continued until just before his

(*w*) Arzneimittellehre, 6te Aufl. p. 268.
(*x*) On the Action of Medicines, p. 91.
(*y*) Med Gaz., vol. xxxiii. p. 734.

death, which occurred in five hours. On dissection, the mucous tissue of the stomach, duodenum, and about one-fifth of the jejunum, was found destroyed in patches. The remaining parts of it could be easily removed by the handle of the scalpel.(*z*) A boy, who swallowed about two ounces of bichromate of potash, was seized in half an hour with vomiting, and became almost totally insensible. He was pale and collapsed, the pupils were dilated and fixed, the pulse feeble, and he had also cramps in the legs. An emetic of sulphate of zinc was given, and the stomach-pump used, until the pinkish color of the washings obtained by it had ceased. He had an attack of gastro-intestinal inflammation, from which he did not recover for four months.(*a*)

CHAPTER VI.

IRRITANT POISONS—(CONTINUED.)

VEGETABLE.

- Colchicum autumnale, § 516.
- Drastic purges.
  - Jalap, scammony, etc., § 518.
- Castor seeds or beans, § 519.
- Fungi.
  - Mushrooms, § 520.

I. *Colchicum Autumnale.* (Colchicum; Meadow Saffron.)

§ 516. (1) *Symptoms.*—The seed and cormus of this plant, and it is said the leaves(*b*) and flowers(*c*) also, are capable of producing violent poisonous effects. The symptoms are, an acute, gnawing pain in the stomach, vomiting and purging, tenesmus, reduced pulse, and great debility. They are said to resemble occasionally those observed in Asiatic cholera, from

(*z*) Beck, vol. ii. p. 666.
(*a*) Guy's Hosp. Rep., 1850, p. 214.
(*b*) Bleifus, Repertor für die Pharmacie, lxix.
(*c*) Magazin für Pharmacie, xxx.

being sometimes attended with cramps in the various parts of the body, ice-cold surface, purging of rice-water stools, suppression of urine, and general collapse. The dose of the medicinal tincture, or the quantity of the crude seeds or bulb, that is requisite to produce the effect described, is not precisely known. The officinal dose of the dried bulb or of the seeds is six or eight grains, and of the wine of either from ten drops to a fluidrachm. A case has been reported in which a person swallowed a wineglassful of the tincture by mistake; he was soon seized with violent pain in the stomach, and vomiting, and died on the next day of exhaustion.(*d*) In another case, reported by Mr. Feraday, the same quantity was taken. The symptoms did not appear for an hour and a half; there was then urgent pain and vomiting, followed by great exhaustion, purging, and tenesmus. In this case the intellect was unaffected. The patient died in forty-eight hours. (The uniformity with which, in the reported cases of poisoning by colchicum, either no mention is made of any cerebral disturbance, or, on the other hand, an express statement is given that the intellect was not at all impaired, justifies the position which we have given to this substance, viz., among the irritants, instead of its customary place among the narcotico-acrid poisons.) Ollivier met with two cases of death within twenty-four hours, in consequence of a tincture being taken which contained the active part of forty-eight grains of the dry bulb, and the period mentioned is the shortest in which death is recorded as the direct effect of colchicum. Dr. Christison states that he has known very violent effects produced by half an ounce taken by mistake, although most of it was brought away by emetics in an hour; and that, in medical practice, he has seldom seen the dose of a sound preparation gradually raised to a drachm thrice a day, without such severe purging and sickness ensuing as rendered it prudent to diminish or discontinue the remedy.(*e*)

(2) The *post-mortem appearances* in *fatal* cases may be those

(*d*) Med. Times and Gaz., 1853, 1.

(*e*) On Poisons, p. 667. For a collection of curious cases, *vide* Ed. Month. Journ. of Med. Sci., 1852, by J. McGrigor Maclagan.

of inflammation, but the evidence of this is extremely equivocal. In a case in which a decoction made with a tablespoonful of the seeds had been taken, and the inspection was made twenty-three hours after death, a remarkable rigidity, especially of the abdomen, was noted. The muscles were of a deep-blue color, as if they had been dried in the air. The heart was covered with spots of a black, violet, and brown color; the stomach was of a light-violet color, and the veins of it and of the intestines much engorged with blood. The other organs had a healthy appearance.(*f*)

The following is an analysis of the lesions found in seven cases of fatal poisoning by colchicum. The skin upon the back and sides was usually purple, livid, violet, or greenish, and decomposition was unusually rapid. The lungs and brain were gorged with dark, imperfectly coagulated, and pitchy blood, and so were the veins of the trunk. In several cases the gastro-intestinal mucous membrane was intensely congested, and in some places softened; in about one-fourth of the number its color was normal. Sometimes ecchymoses were found under the mucous coat, and sometimes also the discoloration extended to the peritoneal membrane.

Of *colchicin* Casper remarks that it is one of the most deadly poisons, and, in its power, hardly surpassed by phosphorus. He relates four cases of fatal poisoning in males between the ages of fifteen and forty. In each of these the dose was between two-fifths and the half of a grain of colchicin; but it occasioned death rapidly, with violent vomiting, purging, and collapse.(*g*)

§ 517. (3) *Chemical examination.*—The possibility of demonstrating the fact of poisoning by colchicum, by means of the extraction of its active principle, *colchicin*, from the *contents of the stomach*, etc., has been shown by Schacht and Wittstock, of Berlin.(*h*) Four persons were poisoned by drinking tincture of colchicum in mistake for "schnapps;" but the fact being somewhat uncertain, a chemical examination of the contents

(*f*) Neubrandt, in Ed. Med. and Surg. Journ., July, 1840.
(*g*) Gericht. Med., i. 402.
(*h*) Casper's Vierteljahrschrift, Jan. 1855.

of the stomach was instituted with the view of detecting, if possible, the presence of colchicin. Previous to the experiment upon the viscera, however, what remained of the suspected liquid was examined, and also a tincture known to be the officinal preparation of colchicum. In both cases colchicin was obtained, and it was found that half an ounce of the officinal tincture of the drug yielded about four and a half per cent. of pure colchicin.

The contents of the stomach were mixed with a large quantity of alcohol, to which a few drops of hydrochloric acid had been added, then shaken, the liquid portion filtered off and evaporated to the consistence of a thin syrup. This residue was dissolved in distilled water, by which much fat was separated, then filtered, carefully evaporated, alcohol added again as long as any foreign material appeared, and then filtered and evaporated as before. To the mass now obtained, after having been reduced by evaporation to about eight ounces, half a drachm of calcined magnesia was used to free the colchicin, and, after a time, three ounces of ether added. This was allowed to evaporate spontaneously after being filtered. The residue was taken up again by water, and evaporated in a watch-glass. The residue gave, with tincture of galls, chloride of platinum, and tincture of iodine, all the reactions of *colchicin*.

Hübler (*i*) regards colchicine as isomeric with colchiceine, and in fact these two alkaloids have occasioned much dispute between scientific men. It is of little matter to the medico-jurist which contains the active principle of colchicum, provided chemistry can isolate and prove the presence of the active poisonous principle. This can be done by treating the stomach, intestines, and liver with strong alcohol, or with alcohol and ether, and then to filter and dilute the filtered liquid with 20 times its volume of water, which separates a fatty oil; then to treat the decanted watery liquid with acetate of lead to remove the coloring matters; and precipitate the lead by sodium phosphate. The solution thus freed from foreign matters is fractionally precipitated with a solution of tannin, which throws down a compound of three parts of colchicine and one

(*i*) Chem. Centr., 1865, p. 536; Jahresb., 1864, p. 450.

part of tannic acid. The middle portion of this precipitate, which is the least colored, is further purified by pressure, and by washing with a small quantity of water; then mixed with levigated litharge and dried; the colchicine is extracted from the residue by alcohol; and the evaporated extract is again subjected to fractional precipitation by tannin and treatment with litharge, till the product exhibits a pure sulphur-yellow color and dissolves completely in water and in alcohol. Colchicine thus obtained is an amorphous substance, having an aromatic odor and intensely bitter taste, forms a yellow precipitate with chloride of gold, white with chloride of mercury, and a curdy precipitate with tannic acid. Alkalies and strong mineral acids color its solution deep yellow. (Hübler.)

Colchicine is soluble in water, and can thus be distinguished from the active principle of veratrum, and does not, like the latter, cause sneezing. It also gives to concentrated nitric acid a dark violet or blue color.

II. *Drastic Purgatives.*

§ 518. The chief articles enumerated under this name are *jalap*, *scammony*, *gamboge*, *colocynth*, *croton oil*, and *elaterium*. With the exception of the last two, they are seldom given singly in medical practice, but generally combined with each other and with milder purgatives, or with mercurials, and always in small doses. That they may give rise to fatal consequences from over-purging is not only possible, but is demonstrated by cases upon record. Being the most usual ingredients of quack cathartic medicines, especially in the pilular form, they have often been taken in large doses, and have thus caused death by the exhaustion arising from over-purging. One element in the consideration of cases in which death is attributed to the use of any of these drugs should not be forgotten, viz., that the very young, or, on the other hand, the aged, cannot bear the operation of violent purgative medicine with the same impunity as those of other periods of life; and also that those who are already enfeebled by disease may readily perish from the effects of a comparatively small dose. In general, where the quantity of a drastic purgative taken has been very large,

there will be found evidence of inflammatory action in the intestines.

White and black hellebore, besides being violent irritants of the stomach and bowels, produce nervous symptoms, such as cramps, convulsions, and delirium. *American or green hellebore* has occasioned similar phenomena in a slight degree, but its poisonous action upon the nervous system is rather shown by vertigo, somnolency or coma, dimness of sight, dilatation of the pupil, and impaired muscular action.(*i*[1])

III. *Castor Seeds or Beans.*

§ 519. It is stated (*Wood and Bache*) that two or three of these seeds are sufficient to purge, and that seven or eight act with great violence. This property depends upon an acrid principle which exists, as is now satisfactorily ascertained, in the embryo. Dr. Hartshorn states that he has known them to be eaten freely with impunity at times, and in other cases to produce the most violent and even fatal emeto-catharsis. Dr. Taylor gives an instance of poisoning by them. A young lady ate about twenty. About five hours after they were eaten, she felt faint and sick; vomiting and purging came on, and continued through the night. On the following morning she appeared like one affected with malignant cholera. The skin was cold and dark colored, the features contracted, and the breath cold; the pulse was small and wiry; there was restlessness, thirst, pain in the abdomen, and she lay in a sort of drowsy, half-conscious state. Whatever liquid was taken was immediately rejected, and the matters passed by stool consisted chiefly of a serous fluid, with blood. She died in five days. On inspection, a very large portion of the mucous membrane of the stomach was found abraded, and softened in the course of the greater curvature. There was general vascularity of the organ, and the abraded portion presented the appearance of a granulating surface of a pale rose-color; it was covered with slimy mucus. The small intestines were inflamed and the inner coat abraded.(*j*)

(*i*[1]) *Vide* action of alkaloids, veratria, §§ 662 and 663.
(*j*) Med. Jur., p 155.

IV. *Fungi.* (Mushrooms.)

§ 520. 1st. There is a vast number of crytogamous plants thus denominated, some of which are generally wholesome as food, while others are exceedingly poisonous. The rules laid down by M. Richard, in the Dict. des Drogues, to persons who eat mushrooms, in their selection, are that those should be rejected that have a narcotic or fetid odor, or an acrid, bitter, or very acid taste; that occasion a sense of constriction in the throat when swallowed; that are very soft, liquefying, changing color, and assuming a bluish tint when bruised; that exude a milky, acrid, and styptic juice; or that grow in very moist places and upon putrefying substances; in fine, all such as have a coriaceous, ligneous, or corky consistence. The last, however, are injurious in consequence rather of their indigestible than of their poisonous nature. Even mushrooms which are usually edible may prove poisonous if collected too late, or in places which are too moist. It is said, moreover, that the poisonous species become innocent when they grow under favorable circumstances; and that the most noxious may be rendered edible by boiling them in water acidulated with vinegar.(*k*) In many portions of Europe, but especially in Poland and Russia, they form the most important part of the food of the common people; and in the latter country whole tribes are mainly supported by them, scarcely any species, except the dung and the fly *agarics*, being rejected. Even those kinds which are elsewhere refused, by common consent, as poisonous, on account of their extreme acridity, are taken with impunity, being extensively dried, or pickled in salt and vinegar, for winter's use.(*l*)

§ 521. 2d. It appears very certain that the poisonous properties of mushrooms may be removed by boiling, and especially with acidulated water, or with vinegar.

Dr. Pouchet, of Rouen, gave a quart of the water in which five poisonous mushrooms (*Amanita muscaria and Avenenata*)

(*k*) On the Medicinal and Toxicological Properties of the Cryptogamic Plants of the United States, by F. Peyre Porcher, M.D., of Charleston, S. C., in the Trans. of the Am. Assoc., vol. vii.

(*l*) Berkeley, ibid.

had been boiled, to a dog, who died in eight hours; but the boiled fungi themselves had no effect upon other dogs. Another, who was fed for two months on little else than boiled amanitas, not only sustained no harm, but actually got fat on his fare.(*m*) M. Gérard exhibited, before a committee of the Paris Council of Health, the complete innocuousness of these two most poisonous varieties, after having been macerated in water. He directs that some two or three spoonfuls of vinegar or some coarse salt should be added to the water, and the fungi macerated for two hours, after which they should be washed, and then put into cold water and boiled for half an hour. They may then be taken out, washed, dried, and used as food.(*n*) In a later number of the same journal, Dr. Gondot relates the cases of seven persons poisoned by eating mushrooms, three of whom died. The mushrooms had been fried in butter. One person ate, the next day, at least half in quantity, of those that had served the family the day previous. These, however, had lain in water for an hour, and were then drained and pressed. In this condition they were fried in butter and eaten. Diarrhœa followed for several hours, but without any other dangerous effect. For a full account of the facts so far ascertained, regarding the distinction between the poisonous and edible mushrooms, we beg leave to refer the reader to Dr. Porcher's admirable essay above quoted, and to Christison and Orfila's treatises on poisons.

§ 521. 3d. The *symptoms* of poisoning by mushrooms or other fungi, are both of an irritant and narcotic character. In Dr. Gondot's cases, the symptoms did not come on until several hours after the meal; in the fatal cases, not until twenty hours, the patients dying in sixteen hours afterwards. They were all affected with vomiting, purging, and cramps. In three cases related by Dr. Peddie, the symptoms began in half an hour, with giddiness and stupor; there were no abdominal symptoms, and the patients recovered. The principal symptoms in sixty-eight cases referred to by Ballardini were nausea, uneasiness in the abdomen, vertigo, a state

(*m*) *Vide* Christison on Poisons. (*n*) Union Méd., 1851, No. 148.

resembling intoxication, vomiting, and diarrhœa, loss of power of locomotion, with convulsions. The following case exhibits a singular form of the narcotic effects. A boy of fourteen, who had eaten the *Agaricus panterimus*, near Bologna, was in the course of two hours seized with delirium, a maniacal disposition to rove, and some convulsive movements. "Ere long, these symptoms were succeeded by a state resembling coma in every way, except that he looked as if he understood what was going on, and, in point of fact, did so."(*o*) The same peculiarity was witnessed by Dr. Harlow in a girl, seven years old, one of a family poisoned by *A. campestris*. "In the wildness of her delirium she rose from her bed and walked into the garden."(*p*) Both the lethargy and the symptoms of irritation may continue for a considerable length of time, and both may occur simultaneously.

§ 522. 4th. The *post-mortem appearances* in the few cases recorded, have been the following: An unusual fluidity of the blood, turgescence of the vessels of the brain, inflammation and even gangrene of the stomach. In one of Dr. Gondot's cases (the only one examined) there was a decomposition of the tissues, the abdominal viscera were softened, and the odor from them was extremely fetid. Dr Maschka, of Prague, has reported seven fatal cases of poisoning by mushrooms, in which, after death, there was an entire absence of cadaveric rigidity, dilated pupils, blood of a dark-brown color mixed with dirty yellow and soft fibrinous clots, numerous ecchymoses and sanguineous effusions in the serous membranes and the parenchymatous organs, and remarkable distension of the bladder with urine.(*q*)

The evidence in cases demanding a legal investigation will most probably be derived from circumstances and the symptoms. The only case which can present difficulty is where an irritant poison has been designedly introduced into the preparation of mushrooms. An instance of this kind occurred: a

(*o*) Christison on Poisons.
(*p*) Boston Med. and Surg. Journ., Aug. 1858, p. 78.
(*q*) Prager Vierteljahrs., 1855, ii. 137.

woman died from the effects of arsenic mixed by her servant with mushrooms. The girl afterwards confessed the fact.(r) Of course, the only means of distinction in such cases is a chemical examination for the suspected poison.

CHAPTER VII.

IRRITANT POISONS—(CONCLUDED.)

ANIMAL.

Cantharides, § 523.
Sausages, § 527.
Trichinosis, § 532.
Poisonous cheese, § 534.
Poisonous fish, § 535.
Unsound meat, § 536.
Mechanical irritants.
Pins, needles, glass, etc., § 537.

I. *Cantharides.*(s)

§ 523. 1st. *Properties.*—The cantharis, or Spanish fly, much used in medicine as a counter-irritant, and also occasionally given internally, is capable of producing fatal results. From the irritation in the genital organs, which is a secondary effect of its use, it has frequently, in ignorance of its dangerous properties, been employed for the purpose of exciting the sexual propensities, and it is occasionally taken also with the hope of procuring abortion. It may produce serious results even by external use. Its vesicating and its irritant property result from the presence of the same principle, viz., *cantharidin*, which has been believed to exist chiefly, if not entirely, in the wing-cases of the insect. From some experiments of Dr. Leidy, the vesicating principle of *Lytta vittata* appears to belong to the blood, the peculiar fatty substance of certain

(r) Christison on Poisons.

(s) Poisons of this class Casper denominates *septic*, because the greater number of them, resulting from animal decomposition, corrupt the blood when taken into the system.

accessory glands of the generative apparatus, and to the eggs.(*t*) Cantharidin, however, is too active for internal use, and is only employed for the purpose of vesication. Cantharides are usually taken in powder or in tincture. In a case reported by Dr. Homans, the powder was taken in mistake for *hiera picra*.(*u*)

§ 524. 2d. The *symptoms* occasioned by an overdose of either of these preparations commence with nausea, vertigo, and a burning sensation in the mouth and throat. This sensation presently extends to the œsophagus and stomach, is succeeded by violent pain and extreme tenderness in the abdomen, thirst, difficulty of swallowing, and vomiting of blood, mucus, and shreds of membrane. There is also violent pain in the loins, strangury, and priapism, and occasionally there is satyriasis with seminal emissions. In the female, swelling and heat of the organs of generation have been observed, and during pregnancy abortion is apt to be produced. It has repeatedly happened that the genital organs were attacked with gangrene, even in cases in which no sexual excitement was manifested. The secretion of urine is, in some cases, suspended; for in a case in which the catheter was introduced, no urine could be obtained. Occasionally profuse salivation occurs, and, in fatal cases, violent cerebral symptoms are observed. A young girl at Windsor was killed by the external application of a blistering ointment, which was rubbed over her whole body in mistake for sulphur ointment which had been prescribed for the cure of the itch. Although the ointment was washed off, the cuticle came with it, and the girl died in five days, with the symptoms above described.(*v*) Guibourt has reported the case of a young man, suffering from acute pleurisy, who, having had a large blister applied to his side, became affected with symptoms of irritation in the urinary passages, and died after falling into a state of complete collapse.(*w*)

§ 525. 3d. The *quantity required to destroy life* is not accurately ascertained. Drs. Wood and Bache state the medicinal

(*t*) Am. Journ. of Med. Sci., Jan. 1860, p. 60.
(*u*) Bost. Med. and Surg. Journ., March, 1855, p. 80.
(*v*) Taylor on Poisons. (*w*) Abeille Méd., xv. 153.

dose as from one to two grains of the powder, and from twenty drops to a fluidrachm of the tincture. It is evident, however, from the frequently deteriorated condition of the powder, that the active principle may, in any given quantity, be found in less than the average amount, and that the strength of the tincture may be often thus impaired. This fact will serve to explain the large quantities which have been sometimes taken without dangerous symptoms. The smallest quantity of the powder which has been known to destroy life, was in the case of a young female, mentioned by Orfila, who took *twenty-four* grains in two doses. She took it to procure abortion, and, as this followed, it is uncertain whether it may not have hastened the fatal result. Much larger doses of the powder have been taken, followed by the most dangerous symptoms, but early vomiting, no doubt, removed a great deal of the poison.

In a case observed by Dr. Ives, of New Haven, a boy of seventeen died from the effects of an *ounce* of the tincture. Death occurred seventeen days after he had taken it. A curious case occurred in France, in 1846, where the ointment of cantharides, consisting of a fourth part of the powder, and three parts of resin, wax, and lard, was administered to a man in his soup, with the intention of poisoning him. The criminal was condemned to death, although his intended victim recovered from the dangerous symptoms which he suffered. The exact dose in this case is not mentioned.

§ 526. 4th. The *post-mortem appearances* are those of inflammation. If a quantity sufficient alone to destroy life has been taken, the œsophagus, stomach, and small intestine will most probably be found highly inflamed, and if the person have lived for several days, the kidneys, ureter, and neck of the bladder also. Such has been the case in the few fatal cases of poisoning by this substance which have been examined. Sometimes the lining membrane of the mouth and throat is destroyed, and in Dr. Ives's case that of the stomach was pulpy and easily detached. In Guibourt's case the kidneys were softened and filled with bloody points; the same appearance was presented by the ureters and bladder, the mucous membrane of which was partially disorganized. A child nearly three years old is said to have rejected by vomiting

the entire mucous membrane of the œsophagus, after taking about a drachm of tincture of cantharides.(x)

The presence of the greenish, gold, or copper-colored scales, derived from the wing-cases of the insect, is, however, the best evidence of the nature of the poison. They adhere very closely to the mucous membrane of the intestines, and may be easily recognized by a common lens. Although there are many other insects which have wings of the same color and are not poisonous, it is hardly possible that these should find their way into the stomach, and much less that they should have been given with any evil intent. M. Poumet recommends also that the suspected liquids which have been vomited should be mixed with alcohol and allowed to evaporate on sheets of glass, by which means the brilliant colored particles of the fly will be visible after evaporation. Or, the stomach and intestine may be inflated and dried, after which, upon cutting them open and examining them upon a flat surface, the particles above mentioned, if present, will be seen sticking closely to the mucous membrane. They are not affected by putrefaction, and, according to Orfila, may be recognized as long as nine months after interment. If, however, the tincture has been taken, this method will not, of course, be available. An effort may be made to detect the cantharidin in the suspected liquid, by digesting in ether what remains after evaporation, and then testing the vesicating properties of the product, but it is evident that the evidence derivable from such a method is very imperfect, if the experiment should not succeed, it being very possible that cantharides may have been used and yet not be detected by these means.

There are several species of fly having similar properties with the Spanish, and which are found in the United States and elsewhere. They are seldom used, however, but could probably be detected as readily as the genuine cantharides.

II. *Sausages.*

§ 527. 1st. *Nature of the poison.*—These and analogous articles of food have so frequently given rise to poisoning in Germany, that we cannot pass them over entirely unnoticed. According

(x) Am. Journ. of Med. Sci., Oct. 1857, p. 560.

to the statistics of Prof. Schlossberger, there have occurred, in the kingdom of Wurtemberg alone, since 1800, no less than 400 cases of poisoning by sausages. Blood and liver-pudding (*blut* and *leber-würste*) constitutes one of the most ordinary articles of the diet of the Germans, and other smoked and fatty preparations, obtained chiefly from pork, are much used. The nature of the sausage poison has only lately been (*vide* § 532) ascertained. Liebig considered it a kind of ferment, Buchner believed it to be due to a peculiar acid which he termed botulinic acid, while Schlossberger considered it to be an organic base. He supported this theory by referring to the now numerous sources of the ammoniacal bases, the transformation of protein combinations by putrefaction, and the very poisonous nature of many of these alkaloids, among which conicine and nicotine are already well known.(*y*) This writer, in a more recent essay, states that the uncertainty regarding the source of the poison continues. He also adds an important fact, that poisonous sausages are eaten by dogs and cats with impunity.(*z*)

What formerly was supposed due to some decomposition has within the past few years been found to be caused by entozoa (*vide* § 532) [Ed. third ed]. The cases of poisoning occur chiefly in the winter and spring months. The unwholesome sausages are described by the last-mentioned author as showing, especially in the interior, little masses of soft consistence like curd; they have a repulsive odor, and a sour, bitter, and rancid taste.

§ 528. 2d. The *symptoms* are well seen in the following narration. The family of Ehrmann at Limmetshausen, with a number of guests, partook of a supper of pork sausages, in consequence of which all were more or less affected with symptoms of poisoning, eight with severe symptoms, and three died. The sausages were made of the liver of a healthy pig prepared eight days previously, slightly boiled, then smoked and hung up. There must have been something peculiar in the taste of the sausages, as one of the guests remarked that they were not wholesome, and did not partake of them, in

(*y*) Canstatt's Jahresbericht für 1850. V. Band, p. 136.

(*z*) Virchow's Archiv, xi. 569.

consequence of which he escaped. The symptoms were similar in all, differing merely in degree. *Shortly after partaking* of the sausages, pains in the bowels, vomiting, giddiness, dryness of the mouth and throat, and difficulty of swallowing came on. The pupils soon became dilated and fixed, the headache and vertigo increased, and the power of vision was lost. Great prostration of strength followed, the power of speech was destroyed, the abdomen was painful to the touch, the pulse small, weak, and frequent, and at last intermittent. The respiration became difficult, and deglutition impossible, lividity of the countenance came on, spasms of the muscles of the extremities ensued, and rapid death. Death occurred within thirty-six hours after eating the sausages.(*a*)

These cases show that the symptoms are not always so slow in appearing as is generally stated. Many other cases might be referred to in which the effects were precisely similar to those described;(*b*) and by comparison they appear to closely resemble the symptoms of trichinosis.

§ 529. In some cases suspicion is wrongly thrown upon the food. Thus in the narrative (communicated by Prof. Röse to Casper's Journal, 1852), of the poisoning of a family by the smoked breasts of geese (*spickgans*), it was found upon chemical examination that a considerable quantity of *sulphate of zinc* was contained in the food. It had been used instead of saltpetre in its preparation. The symptoms were of a choleraic nature, and nothing like the narcotism produced by sausage poison was observed.

§ 530. The *post-mortem appearances* in the cases seen by Roeser were the following. The brain and spinal marrow were healthy. The palate and tonsils were red, the last much larger than natural, the lining membrane of the larynx was of a deep blue color, and that of the trachea and bronchia of a blackish-red color. The lungs were highly congested and condensed. The œsophagus was of a remarkably white color, and covered with a white false membrane. The stomach and intestines internally were mottled with red spots, and the du-

(*a*) Roeser, Am. Journ. Med. Sci., April, 1843.

(*b*) *Vide* Kussmaul. Ver. deutsch. Zeitsch., v. ii. 1849. Two children out of a family of seven died.

odenum had a black appearance. The other organs were nearly natural in their aspect. Similar appearances have been observed in other cases.

§ 531. In December, 1841, over forty cases of cholera morbus occurred in New York, which, according to Dr. Lee, were traced to some smoked beef, sold from a particular grocery, and of which the individuals attacked had freely eaten. The symptoms did not generally make their appearance until several hours after the beef had been eaten. They commenced with pain and uneasiness in the præcordial region, which extended to the back and loins, and were only temporarily relieved by the dejections which followed. Vomiting soon came on, attended with great thirst and a burning sensation at the pit of the stomach, and the irritability of this organ became so great, that no substance, either as food or medicine, could be retained for an instant. Extreme prostration followed; the functions of the nervous, muscular, and the digestive system were much impaired, and convalescence was very slow and protracted. In one case, that of a girl six years of age, the disease proved fatal on the fifteenth day; and on dissection the blood was found fluid, the mucous coat of the ileum deeply injected, and inflamed; the other organs were healthy.(*c*)

§ 532. The opinion among physicians of the present day is, that most of the cases of poisoning by these sausages is due to a disease called *trichinosis*, which is supposed to be caused by the presence of a flesh-worm (*trichina spiralis*) which infests the muscular tissue of pigs. Meat containing this insect has a number of small white dots interspersed among the muscles; and the appearance of this insect under the microscope is so well known among physicians and naturalists as to require but a passing notice in this work. Cases of persons afflicted with *trichinosis* in the western part of our country have been reported. For a thorough description and a very full account of the natural history and appearance of the trichinæ, reference is made to a lecture by Prof. John Dalton, M.D., reported in the *N. Y. Medical Record*, April 1, 1869, as well as in the *Boston Med. and Surg. Journal*, May 6, 1869. Dr. Dalton

(*c*) Copland's Dict., Am. ed., art. Cholera.

states that one-fiftieth of all the pigs brought into the market at Chicago in 1866 were infested with trichina. To kill the worms, the ham must not only be salted and smoked, but must be subjected to a temperature of 212° F., and continued for a considerable length of time, so that each portion of the meat (central as well as outside) should attain that temperature.

§ 533. *Symptoms of the disease.*—The absence of all intestinal symptoms, as well as severe attacks of vomiting and purging, is only exceptionally observed after the use of trichinous flesh. The greater number complain in a few hours, or not till a few days after the poisoning, when the young brood has been hatched, of severe pressure in the stomach, of eructation and nausea, combined with a feeling of great heaviness and depression. There is almost always diarrhœa, the discharges being brownish, afterwards yellow, thin, and accompanied by more or less severe colicky pain. These gastric symptoms are followed, sometimes also accompanied, by vague muscular pains, stiffness, swelling, and œdema of the eyelid, and sometimes a peculiar staring expression to the eyeball (Kittell) due to the infection of the muscles which control the movements of the eye. The muscular pains become more severe on motion, and soon the different muscles swell considerably and become tense and hard. Cohnheim describes the patient's position: "He lies on the back with the shoulder and elbow-joints sharply bent, and the hands slightly flexed; on the other hand, the knee and hip-joints are but slightly bent, or nearly straight; so that he can neither lift the arm, extend the forearm, sit up, nor bend the knees."(*c*[1]) There is also an insidious form of the disease, the gastric disturbance not being very great; but often these apparently mild cases assume the violent and dangerous form. Death in this disease is not uncommon during the first two weeks; children have a certain immunity to trichinosis, perhaps because they do not digest a part of the meat.(*c*[2]) The attestation of poisoning by the trichina can always be proved by the microscopic appearance of the muscular tissues.

(*c*[1]) Niemeyer, vol. ii. (*c*[2]) Ibid., op. cit.

III. *Poisonous Cheese.*

§ 534. The nature of the poisonous quality occasionally acquired by cheese, is not more precisely known than that of sausages; it is supposed by Hünefeld and Sertürner to depend upon two animal acids, analogous to, if not identical with, the caseïc and sebacic acids. According to the researches of Proust, the sharp, peculiar taste of old cheese is owing to the gradual conversion of the curd of caseïne into the caseate of ammonia, which in sound cheese is always united with an excess of alkali. But if the fermentation has been too much hastened, or allowed to go too far, a considerable excess of caseic acid is formed, as well as some sebacic acid. According to Hünefeld, the deleterious cheeses are yellowish-red, soft, and tough, with harder and darker lumps interspersed; they have a disagreeable taste, redden litmus, and become flesh-red instead of lemon-yellow under the action of nitric acid.(*d*) Instances of poisoning by cheese have been hitherto observed chiefly in Germany, some few in England, and within a few years in this country also.

Dr. Parrish has given an account of several cases which fell under his observation in Philadelphia.(*e*) A poor family, consisting of a laboring man and his six children, after a meal composed of tea, bread and cheese, were seized with severe vomiting and purging, with dizziness of the head and great prostration of strength; the liquids discharged from the stomach and bowels were thin and watery, and not very dissimilar to the rice-water discharges of cholera. The attacks were frequent and distressing, and the cases exhibited, at first view, very much the appearance of poisoning from some metallic irritant. These symptoms occurred within an hour after partaking of the meal, and the mother of the family, who was alone unaffected, had been absent from dinner on that day. On the following day all of Dr. P.'s patients had recovered. Similar symptoms having occurred in numerous instances in the same neighborhood, after eating cheese obtained from the

(*d*) Christison on Poisons, p. 495.
(*e*) Trans. Col. Phys., Jan. 1854.

same grocer, inquiry was made of him, and it was found that the cheese from which the deleterious slices had been cut, was one of a large lot from a celebrated dairy in New York, all of which up to that time had produced no unpleasant results, but on the contrary had been considered remarkably good. There was nothing in the taste or external appearance of the remnant to indicate any poisonous properties. It was moreover tested by a competent chemist, and no mineral poison was detected in it. Dr. P. was unable to explain the sudden development of poisonous properties in any other way than by reference to the peculiar state of the atmosphere existing at the time. "It was in the month of January, during a spell of remarkably damp, foggy, and mild weather, succeeding to a cold atmosphere. In the two days during which these cases occurred, the air was loaded with moisture, and the fog on the Delaware was so heavy that the boats were very much impeded in crossing. Might not the softening of a mass of cheese, after being hardened by freezing, develop deleterious properties?" He also considers that the fact of the cheese being mild and newly made, would favor the changes referred to.

IV. *Poisonous Fish.*

§ 535. There can be no doubt, as Dr. Christison observes, "that the subject of fish poison is one of the most singular in the whole range of toxicology, and none is at present veiled in so great obscurity." In many cases it is possible that the symptoms of poisoning may be due to the fish having been kept too long, in others to its mode of preparation, as by pickling or smoking; but nevertheless some few cases will still remain in which the freshest and usually most wholesome fishes have caused symptoms of irritant poisoning. These cases are, however, far more common in tropical countries, their occurrence in this latitude being so rare, that it is reasonable to suspect either idiosyncrasy on the part of the persons eating the fish, or some deleterious quality acquired by it after its removal from the water.(*f*)

(*f*) Consult Moreau de Jonnés, Recherches sur les poissons toxicophores des Indes Occidentales, Annales de Thérapeutique, i. 461; Guillon, Abeille

1st. *Oysters* have not unfrequently proved dangerous. On several occasions in France, they appear to have become suddenly unwholesome.(*g*) In the autumn of 1854, numerous deaths in our principal cities were ascribed to their use, and it was generally conceded that for a period of a few weeks in the month of October, they frequently gave rise to choleraic symptoms. No clue to the nature of the poison was in this instance, or in any of the previous epidemics in France, obtained by chemical examination. We doubt very much whether *crabs* and *lobsters* acquire any peculiar poisonous quality apart from their general unwholesomeness as articles of food, if not eaten too long a time after their capture.

2d. *Mussels*, however, by general consent seem to have a specific poisonous property accorded to them. The idea that it is due to an impregnation from copper is wholly untenable, since not a trace of this metal has been discovered in those taken from the stomachs of persons who have been killed by them. Unquestionably, in many instances, idiosyncrasy is the cause of the mussel proving unwholesome to some individuals. This, also, is the conclusion at which M. Lunel arrives after a careful investigation of the subject.(*h*) But it need hardly be remarked, that it, after all, amounts to a confession of our ignorance of the efficient cause of poisoning by these shell-fish.

In the cases described by Dr. Combe, of Leith, not only were the mussels perfectly fresh, but every person who ate those from a particular spot was more or less severely affected, and even animals were poisoned by them, a cat and a dog having been killed by the suspected article. Dr. Christison was unable to detect in them any principle which did not exist in the wholesome mussel. Many cases descriptive of the symptoms have been reported. The following is a recent one: A boy aged ten years ate the thick part of two mussels; forty-

Méd. xiii. 67. See also an account by Dr. Hamilton, in the London Pharmaceutical Journal, Jan. 1858, p. 344.

(*g*) Mém. sur les Empoissonnements par les Huitres, les Moules, les Crabes et par certains Poissons de Mer et de Rivière, par A. Chevallier et E. A. Duchesne. Ann. d'Hyg. vol. li.

(*h*) Abeille Méd., Juin, 1857, p. 173.

five minutes afterwards he complained of uneasiness in his stomach; he had a sensation of heat, giddiness, and a desire to vomit; there was an eruption of nettle-rash over the whole body as far as the knee, attended with swelling of the face and intolerable itching; after an emetic, the symptoms disappeared completely.(*i*) Very much the same symptoms were exhibited by the persons seen by Dr. Combe.(*j*) In the fatal case of an adult of intemperate habits, reported by Dr. Lee, who, with his whole family, seven in number, were poisoned by eating mussels, the attack commenced with severe distress in the stomach, followed by vomiting and purging, painful muscular spasms, with great anxiety and prostration; the pulse was frequent and feeble, the skin of a deep crimson or livid color, and covered with a cold, clammy sweat; sleeplessness, subsultus tendinum, and delirious agitation, great heat at the epigastrium, the rest of the surface being cold, pupils contracted, face sunken; voice and intellect unaffected until four hours before death, about which time vomiting of matters resembling coffee-grounds came on; death occurred about forty-eight hours after the time of the attack.(*k*) Chevallier and Duchesne report a number of cases of poisoning by the *roes* of a fish called the barbel (barbillon), and several cases of a similar origin are reported by Dr. Trapenard.(*l*) The symptoms were such as would be produced by a violent emeto-cathartic; copious evacuations, and constant efforts to vomit, headache, frequent pulse, great pain, and an insupportable sensation of heat.

V. *Unsound Meat.*

§ 536. The symptoms produced by the use of unsound meat are similar to those arising from irritant poisoning, but in addition there are typhoid symptoms which indicate the contamination of the whole body by the products of decomposition. In some cases related by Dr. Christison, the patients

(*i*) Guy's Hosp. Rep., 1850, 213.

(*j*) Ed. Med. and Surg. Journ., xxix. 86.

(*k*) Am. ed. of Copland's Dictionary. Art. Cholera.

(*l*) Ann. d'Hyg. 1850, and Journ. de Chimie, 1851, p. 584. For a recent case, see Edinb. Med. Journ., April, 1860, p. 958.

were soporose or delirious, and one died comatose in six hours after eating a portion of a putrefied calf. The rest, being freely purged and made to vomit, eventually got well; but for some time they required the most powerful stimulants to counteract the exhaustion and collapse which followed the attack.(*m*) Game which has been long kept may be the source of the symptoms of irritant poisoning. In this country the flesh of the pheasant (*Tetrao umbellus*), when snow is upon the ground, is apt to prove unwholesome to some, in consequence, as is supposed, of the bird feeding upon the leaves and berries of the laurel.(*m*[1]) It is doubtful, however, whether this explanation is correct. Dr. Bigelow suggests as probable solutions of the difficulty: 1. That the bird is affected with some disease at the time of its death. 2. That some slow chemical change, not putrefactive, may take place when the flesh is long kept in cold weather. 3. That the idiosyncrasy of individuals renders some persons intolerant of this species of food.(*n*) Instances of arsenical poisoning resulting from the eating of birds who had fed upon grain steeped in a solution of this poison, to preserve it, are not unfrequent in England and France, where this process is chiefly in use.

VI. *Mechanical Irritants.*

§ 537. There is a vast number of indigestible substances which, when introduced into the stomach, may give rise to fatal consequences. Pins and needles and powdered glass are those which, in case of death, are most likely to give rise to a suspicion of their having been criminally given. Naturally, such questions can be reasonably raised only in the cases of children or imbecile persons; although, indeed, at one time, glass in powder was considered as extremely poisonous, and was occasionally criminally administered. Thus, in France,

(*m*) Articles on diseased meat as affecting the health may be found in Brit. and For. Med.-Chir. Rev., Jan. 1858, p. 87, and in North Amer. Med.-Chir. Rev., May, 1858, p. 483. Duchesne has written on the unwholesomeness of poultry fed on diseased meat, Ann. d'Hygiène, 2ème sér. xi. 63, and Roeser on that of over-driven cattle, Prager Vierteljahrs. xl. anal. p. 86.

(*m*[1]) *Vide* Hydrocyanic Acid, § 583.

(*n*) Nature in Disease, p. 287.

in 1808, a man was tried for poisoning his wife with this substance. It was found in the stomach, but there were other causes which might have produced death. A negro woman, in Jamaica, attempted to poison a whole family with pounded glass, put into a dish of curried fish. The fact was discovered towards the end of the meal, and purgatives were given, which brought away large quantities of coarsly powdered bottle-glass. The persons did not suffer any inconvenience. Dr. Bowling, of Kentucky, obtained as much as eighty grains of powdered glass from the discharges of a child. It had not suffered at all.(*o*) Nevertheless, Dr. Christison reports a case in which a child, eleven months old, was evidently killed by it.(*p*)

Pins and *needles*, when swallowed, rarely cause death; they frequently emerge from various parts of the body or are found after death in the viscera. Thus a case is related in which a needle was found in the kidney, in another in the liver, in another in the heart, and in another across the œsophagus; the point of it had, in the last case, penetrated the common carotid artery, and produced fatal hemorrhage. Sometimes, no doubt, they are thrust under the skin by hysterical patients, animated by a morbid desire of attracting attention and curiosity. They may be the accidental cause of death in many ways, but the most usual is that of disturbance of the digestive functions. A girl, twelve years of age, to avoid work, swallowed pins and needles, of which nineteen of the former and five of the latter were passed from the bowels. She suffered occasional colicky pain, and had much swelling and hardness of the abdomen.(*q*) A case is related,(*r*) in which a woman eventually died from the continued irritation produced by a quantity of needles she had swallowed. The stomach, which was enormously enlarged, contained *nine* ounces of pins of a purple-black color, and the duodenum contained a *pound* of the same. In the body of a lunatic who died suddenly of peritonitis, in the Peekham House Asylum, the fol-

(*o*) West. Journ. of Med. and Surg., Nov. 1848.
(*p*) Op. cit., p. 504.
(*q*) Boston Med. and Surg. Journ., Oct. 1859, p. 227.
(*r*) Lancet, Am. ed., 1852, p. 224.

lowing articles were found in the stomach: thirty-one entire spoon-handles about five inches long, four half-handles, nine nails varying in size from a garden-wall nail to a spike nail, half of the iron heel of a shoe, a screw two and a quarter inches long, four pebbles, and one metal button, weighing in all two pounds eight ounces. The whole of them were stained of a black color, and the angular articles rounded off and blunted. In the duodenum an entire spoon-handle was found, and here the perforation occurred which caused the peritonitis.(*s*)

A case in which a mass of hair and string, weighing from eight to ten pounds, was taken from the body of a girl aged eighteen, who had been in the habit of swallowing these substances, is related in the same journal.(*t*) A remarkabl instance of the passage of a tinned iron fork through the whole alimentary canal was communicated to the French Academy of Medicine by Velpeau.(*u*) Another in which death was caused by eating raw rice.(*v*) M. Gosselin related, to the Surgical Society of Paris, the case of a man who swallowed a clay pipe three inches and a half in length. It occupied two months in passing through the bowels, and at the end of this time it was discharged unbroken. But the man's health had suffered severely from the irritation it had caused, and he died five days after its discharge.(*w*) Cases such as have been enumerated in this chapter are evidently rather subjects of curiosity than of any importance in legal medicine.

(*s*) Lancet, 1852, vol. ii. p. 296.
(*t*) Vol. i. 1852, p. 224.
(*u*) Ibid., 1849, p. 246.
(*v*) Ibid., April, 1847.
(*w*) Ibid., 1851, vol. ii. p. 462.

CHAPTER VIII.

NARCOTIC POISONS.

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§ 538. The name *narcotism* is applied to a certain condition of the nervous system produced by the action of a class of poisons called narcotic.

The effects of poisoning by the narcotics are: heaviness of the head, vertigo, exaltation of the senses, increase of temperature and of the impulse of the arteries (caused by a congestion of the smaller bloodvessels), dryness of the throat and skin, nausea, vomiting, diminution and suspension of all the secretions and very lively *pruritus* (extreme itching of the skin), often accompanied by papular or vesicular eruptions; a drowsiness sometimes profound from the commencement, relaxation of the extremities, suffusion of the face, a fixity of expression of the eyes, and sometimes dilatation of the pupil, generally a stertorous respiration increasing until death, which generally takes place from seven to twelve hours after the ingestion of the poison, but may be hastened by the contraction of the thoracic muscles or diaphragm, or by convulsions. Recovery is marked by an abundant perspiration, and by the successive return of sensation and intelligence.

§ 539. The lesions determined by the narcotic poisons are principally a very intense congestion of the principal organs, especially of the lungs and brain; the blood is black and fluid. They resemble in this respect the action of certain deleterious gases, coal gas, etc. These latter effects are probably due to the imperfect aëration of the blood from an embarrassed respiration occasioned by the spasms of the muscles concerned in the act of inspiration and expiration.

Cerebral or pulmonary apoplexy and congestion of the brain may be mistaken for poisoning by the narcotics; but the first can generally be distinguished by a contraction of some few of the muscles of one side of the body, especially of the face and mouth; the second, if no vomiting or expectoration of blood occurs, could be distinguished at the autopsy and chemical examination.

I. *Opium and its Preparations.*

§ 540. 1st. The *symptoms* produced by a poisonous dose of opium or its preparations, differ from those which are occasioned by moderate and remedial doses of the drug. While

in the latter the purely narcotic effects do not occur without a certain degree of previous exhilaration and stimulation, in the former dizziness and stupor are the first symptoms, or the excitement is so temporary as to pass unnoticed. The main characteristic of poisoning by opium is the profound somnolence which it occasions, and which is not preceded by active delirium. When under the full influence of this narcotic, the patient lies in a deep lethargy, his eyes are closed, the pupils extremely contracted, the face generally red, the limbs relaxed, and the skin is dry. Respiration is slow, and sometimes stertorous. If no efforts are made to save life, or if medical assistance is fruitless, the stupor deepens, the patient can no longer be even momentarily awakened, his pulse becomes feeble and imperceptible, and he dies comatose. Copious perspiration is a singular and infrequent symptom. It is mentioned by Christison, who says that in one case "the sheets were completely soaked to a considerable distance around the body;" and Dr. Morland observed it, in an equal degree, in a case he has reported.(*a*) Delirium is very rare, and, when it occurs, is of a passive character. In the adult, *convulsions* have been seldom observed, although one or two curious cases have been reported in which they were witnessed. In children, however, they are not uncommon. Occasionally spontaneous vomiting takes place, especially after the ingestion of the drug in large quantities, and some instances have occurred in which this early rejection of the poison from the stomach has saved the life of the individual. A child nine years of age, mentioned by Dr. Coale, recovered in this way after having swallowed four grains of opium and four of extract of belladonna. The pulse also varies in character, being usually feeble and irregular, but sometimes full and slow; in a case reported by Dr. J. B. S. Jackson, it is described as "rapid, full, and throbbing." Such differences depend often, probably, upon the variable periods at which the observation is made; thus, the skin is warm and perspiring, and the pulse rapid and feeble, or perhaps even strong, early in the case; while later, if the patient get worse, the surface becomes cold and pale, and the pulse slow,

(*a*) Am. Journ. Med. Sci., Oct. 1854.

feeble, and irregular. Much also may depend upon the constitutional irritability of the system.

The differences between poisoning by opium and by other narcotics are briefly these: aconite, digitalis, and tobacco do not produce stupor, nor does conium, except in very large doses, and even then not uniformly; hyoscyamus, stramonium, and belladonna excite violent delirium, and extreme dilatation of the pupil. Inebriation by alcohol bears a very close resemblance to opiate narcotism in many cases, but the former is preceded by confusion of ideas or complete delirium, and the breath is strongly tainted with the alcoholic odor.

§ 541. The symptoms usually commence, in the adult, within an hour after the poison has been taken, but sometimes the confirmed narcotic effects do not come on until a later period. In a case quoted by Dr. Taylor, the patient was found totally insensible in fifteen minutes. In Dr. Lyman's case,(*b*) a female, after taking an ounce of laudanum with suicidal intent, began very suddenly, in thirty-five minutes, to lose her pulse and muscular power, and had slight spasms; the lips became livid, there was spasmodic dropping of the lower jaw, the extremities were cold, and in ten minutes more she was unmistakably dead. Thus, three-quarters of an hour only elapsed from the ingestion of the laudanum to her death. Dr. Coale(*c*) states that he met with a case fatal in the same time, and Dr. Taylor quotes a similar one. Dr. Beck reports a case which proved fatal in two hours. Another is given which terminated in two hours and a half.(*d*)

§ 542. 2d. The *average duration* of cases of poisoning by opium is stated by Christison to be from eleven to twelve hours. The rapidity, or indeed the certainty, of death does not always correspond with or depend upon the amount taken, when this is beyond the limits of safety. Among the cases above referred to is one by Dr. Jackson, which recovered, although ninety grains of opium were taken, and no relief was afforded for three hours afterwards. In the case mentioned by

(*b*) Am. Journ. Med. Sci., Oct. 1854.
(*c*) Am. Journ., Jan. 1850, p. 73.
(*d*) Bost. Med. and Surg. Journ., vol. xi. p. 285.

Dr. Taylor, of a man who had taken from twenty-eight to thirty grains of opium, the symptoms were so little characteristic of poisoning by this drug, that no suspicion was entertained of its having been used, and death took place rather suddenly in ten hours after the fatal dose had been swallowed.(*e*) On the other hand, the most rapidly fatal case yet recorded was the one above referred to, in which only an ounce of laudanum was swallowed. The fact should, however, be borne in mind, that laudanum, or any *solution* of opium, is more prompt in its effects, because it is more readily absorbed than solid opium.

§ 543. 3d. *Amount.*—Owing to the varying susceptibility of individuals to the poisonous action of opium, it is not possible to state the *amount* which will be uniformly fatal. A case is referred to by Dr. Taylor, in which four grains proved fatal, and another in which death was supposed to have resulted from a dose of two drachms of laudanum, but it was uncertain whether as much as half an ounce had not been swallowed. A gentleman affected with acute rheumatism died comatose after taking, at intervals of an hour, four pills, each of which contained one-third of a grain of morphia.(*f*) In Dr. Lyman's case, one ounce of laudanum was the cause of speedy death. The smallest dose which has proved fatal to a child is the one-twentieth of a grain of opium.(*g*) The child was six days old. Dr. J. B. S. Jackson met with a case, in 1845, in which five drops of laudanum, injected into the rectum of a child eighteen months old, caused death in six hours. Instances are quoted by all the writers on toxicology, of death in children from extremely small doses, such as the one-tenth or the one-fifth of a grain, and most practitioners have witnessed alarming symptoms from a few drops of laudanum, or fractional doses of Dover's powder, given to children. In many instances these have been dissipated only by active medical interference, such as cold affusion, galvanism, etc.(*h*)

(*e*) Med. Jurisp., 6th ed., p. 162.

(*f*) Med. Times and Gazette, June, 1860, p. 254.

(*g*) Dr. E. Smith, Assoc. Med. Journ., April, 1854.

(*h*) *Vide* I. Young's case, and the references given by Dr. Hays, Am. Journ. Med. Sci., April, 1852, p. 426; also a very instructive case by Dr. Herapath, where respiration was artificially maintained by means of the gal-

Trousseau states that he has seen narcotic effects in children from a dose of the wine of opium equivalent to less than the one-hundredth of a grain of this drug. It is well known that a child may be narcotized by the milk of a nurse who has taken opium. Bouchardat relates that nine new-born children were narcotized by the decoction of a single poppyhead. In London an infant four days old was destroyed by one-twentieth of a grain of opium, or about one drop of laudanum;(*i*) and in Edinburgh the same effect was produced by two drops of laudanum, in an infant also four days old.(*j*)

The following cases prove the possibility of recovery after excessive doses of this drug. A gentleman seventy-two years of age recovered from the effects of twelve drachms of laudanum;(*k*) another, aged thirty-five years, after half an ounce of this preparation had been taken;(*l*) in a third case above an ounce was swallowed, and, although the symptoms were intense, the patient recovered, temporarily at least, with paralysis of the right side.(*m*) Another case is reported, in which ninety grains of opium were taken by a female, who, however, recovered.(*n*) An infant of twelve months has recovered from the effects of seventy-two drops of laudanum;(*o*) another, six days old, after two grains of powdered opium;(*p*) and a child, not quite six years old, from a dose of seven and a half grains of opium, which were, however, mixed with an equal quantity of prepared chalk.(*q*)

The tincture of opium is liable to considerable variations in strength; and although in adults the difference of effect will hardly, within certain limits, be perceivable, it may certainly be so in children, on whom this drug has, moreover, always a

vanic battery until the narcotism passed off, and the child was saved. Lancet, Am. ed., 1852, p. 450.

(*i*) Times and Gazette, April, 1854, p. 386.

(*j*) Edinb. Med. Journ., ii. 146.

(*k*) Lancet, July, 1857, p. 80.

(*l*) Bost. Med. and Surg. Journ., Aug. 1855, p. 21.

(*m*) Brit. and For. Med.-Chir. Rev. xxii., 523.

(*n*) Am. Journ. Med. Sci., Oct. 1854, p. 385.

(*o*) Edinb. Med. Journ., iii. 716.

(*p*) Boston Med. and Surg. Journ., Dec. 1857, p. 357.

(*q*) Am. Journ. Med. Sci., April, 1859, p. 367.

disproportionately speedy action. The quantity of soluble matter taken up by the menstruum is subject to great variation, since the purity of the opium, its comparative strength in morphia, the strength of the spirit used as a solvent, and the period of the maceration, will undoubtedly affect the result materially. The tincture, properly prepared, should contain one grain in 12.8 minims, or about twenty-five drops. Godfrey's cordial contains a little more than one grain of opium in the fluidounce.(*r*) Dalby's carminative mixture has five minims or ten drops of laudanum in two ounces. The conditions of absorption by the stomach depend upon the question of the poison being administered in a solid state and to a fasting stomach. In solid form and on a full stomach the drug is not so readily absorbed.

§ 544. The fatal consequences arising from the constant and ignorant use of nostrums containing opium or its alkaloids in domestic practice are undoubtedly very frequent. There is a certain chronic poisoning induced by the use of this drug and its derivatives (especially morphia), which has only recently been brought to notice. Paregoric and certain "soothing syrups and powders" given to children by ignorant persons in order to produce quiet and sleep, have been proved very injurious to health, and in a few instances death has been caused.(*s*) The children, however, become tolerant of the poison, and, though their death may not be immediately attributed to the continued use of the narcotic, yet their constitution becomes undermined. "In the late Mr. Grainger's report on the Children's Employment Commission, it is stated that laudanum and other preparations of opium are given to young children in gradually increased doses until the child will bear from fifteen to twenty drops of laudanum at a time.(*s*^{1}) The majority of these children die by the time they are two years old."

§ 545. 4th. The influence of *idiosyncrasy* in modifying the

(*r*) Wood and Bache's Dispensatory.

(*s*) California Medical Gazette, Nov. 1869; Am. Journ. of Pharmacy, May, 1872, p. 221, from Pacific Med. and Surg. Journ.

(*s*^{1}) Taylor, Med. Jurisprudence, 1865, p. 1154.

usual effects of opium are often seen, and may be of importance in legal medicine. Thus Grisolle states, that he saw narcotism induced in a lady by half a grain of opium. Dr. Christison mentions the case of a gentleman who was always narcotized by so little as seven drops of laudanum, and Taylor observed alarming symptoms from the injection in a clyster of one grain of opium. Some authors contend that the drug is even more active by the rectum than when swallowed. Some diseases render the system extremely susceptible to its poisonous action, and this is particularly the case in all those affections attended with a plethoric condition of the bloodvessels. On the other hand, painful diseases enable the person to use very large doses, not only without injury, but with positive advantage.

§ 546. The habit of taking opium diminishes the influence of this drug upon the system, and doses, which in other cases would be absolutely poisonous, are taken with entire impunity, by persons who indulge in this habit. The influence exerted by the habitual use of opium upon the *duration of life* does not appear to be so unfavorable as, from the powerful action of the drug upon the system, might at first be supposed.(*t*) The picture of the opium eaters and smokers of the East, as drawn by travellers, is indeed a melancholy one, and their general testimony is, that *there* it undoubtedly has the tendency to shorten life. This is the conclusion arrived at by Mr. Little, of Singapore, as the result of careful and extensive inquiries at that place of the owners of opium shops, of the smokers who frequented them, the prisoners in the house of correction, and the paupers of a poor house. The following picture of the effects of the habitual use of opium is drawn by this gentleman: "As the habit grows upon its unhappy victim, the first

(*t*) This subject received particular attention from Dr. Christison in consequence of its importance in a remarkable civil trial. The Earl of Mar effected insurances on his life to a large amount while addicted to the vice of opium eating, and died two years afterwards of dropsy. He had used laudanum for thirty years, at times to the amount of two or three ounces daily, and died at the age of fifty-seven. He suffered greatly from rheumatism. The insurance company, having been unaware of this habit, refused payment on the ground of its having a tendency to shorten life. The persons holding the policy, therefore, instituted an action against the company, which was decided in favor of the former, but on other grounds.

evils experienced are disturbed sleep, watchfulness, giddiness, sometimes headache, capricious appetite, a white tongue, frequently costiveness, indescribable oppression in the chest, and haziness of the eyes. Afterwards a copious secretion of mucus takes place from the eyes and often from the nose also; digestion becomes much impaired and micturition difficult; a mucous discharge begins to flow from the organs of generation; the sexual organs, at first preternaturally excitable, gradually lose their tone; the body wastes, the muscles lose their torosity, and the bones are affected with dull gnawing pains for some hours in the morning. By and by the figure stoops, and a peculiar shuffling gait is acquired, by which alone a practised eye may recognize an old opium debauchee. At the same time, the eyebrow droops, the lower eyelid becomes dark, the eye itself seems to sink and grow dim, and the whole expression is that of premature old age. In both sexes the procreative power is greatly lessened, and in those women who, nevertheless, do bear children, the secretion of milk is defective. The influence of the habit on the generative functions is indeed so decided, that, were it not for fresh arrivals from China and other parts of the East, the population of Singapore would very soon be seriously diminished."(*u*) Finally, according to this author, structural derangement is induced, the digestive and assimilative functions become very much impaired, strumous affections are readily developed, and the opium smoker succumbs without resistance under any violent disease.

Some Eastern travellers, however, assert that the habit has no tendency to shorten life. Thus Dr. Macpherson says, that, although the habit of smoking opium is, in China, universal among rich and poor, we find them to be a powerful, muscular and athletic people; and Dr. Burnes, who resided several years at the court of Scinde, says, that "it will be found in general that the natives do not suffer much from the use of opium.(*v*) A celebrated Cutchee chief, who had taken opium largely all his life, was alive at the age of 80, paralyzed by years but his mind unimpaired."

Dr. Christison, moreover, found upon an examination of

(*u*) Edinb. Month. Journ., June, 1850. (*v*) Christison on Poisons.

twenty-five cases, the particulars of which he obtained from various quarters, that instances of longevity among opium eaters in Great Britain were not uncommon. In most of these cases it is expressly stated that no injurious effect upon the general health was observed; in some instances, indeed, the persons being ruddy and robust in appearance. In a few, unpleasant symptoms were experienced only upon the intermission of the habit. The only inference that can at present be drawn from the testimony of travellers, and from these observations reported by Dr. Christison, is adverse to the general belief that opium, like intemperance in strong drink, has a tendency to shorten life when habitually used. Future observation must decide whether this reasonable belief is really the correct one. The possibility of abruptly discontinuing the habit without injury to the constitution has been shown by Dr. Christison.(*w*)

§ 547. There is no doubt in the minds of medical men of the present time that the habit of opium eating is injurious to health, and therefore calculated to shorten life. In any proposal for life insurance the insurers ought to be informed of this habit, where it exists, and no medical man should sanction its concealment merely because many persons addicted to the habit have lived for years in tolerable health. The practice often is, and may be, concealed from a medical attendant; then the insured, if not candid in avowing its existence, must expose his representatives to the risk of losing all benefit under the policy.(*w*[1])

§ 548. 5th. *Post-mortem appearances.*—It is quite unnecessary to particularize the morbid alterations which have been seen in persons dying from poisonous doses of opium, since there is none which are sufficiently constant or distinctive to be attributed to this cause. As a general rule, the vessels of the brain and spinal marrow will be found turgescent and the lungs and other vascular organs congested, while the blood remains fluid. The multitude of diseases and of accidental modes of death which may occasion these conditions preclude us from attaching any importance to them as indicative of

(*w*) Edinb. Month. Journ., June, 1850.

(*w*[1]) Taylor, Med. Jurisprudence, 1865, p. 1155.

death from opium. Sometimes opium in substance or laudanum may be found in the stomach, or the latter recognized in this organ by its smell, but in the vast majority of cases the poison is rapidly absorbed or eliminated from the system, so that at the post-mortem inspection no trace of it will be found.

Though the lesions which have been noticed in the organs of those poisoned by opium have no very specific character, still they are almost always constant. The stomach and intestines are sometimes colored on their interior aspect by the saffron-yellow tint of opium. The mucous membrane shows varied and striking tints, formed by the mixture of the coloring matter of the medicament with the arboriform injections of the bloodvessels, thus adding a vivid red to the yellow color (Tourdes.) At first sight it would be reasonable to attribute the effects to poisoning by nitric acid, were it not that the absence of injury to the tissue removes the doubt. Generally the mucous membrane of the alimentary canal is free from alteration. The surface of the body is completely discolored, and animal heat persists for a long time, even after the invasion of cadaveric rigidity.

§ 549. 6th. *Poisoning by morphia* or its salts requires no separate consideration. The symptoms are rather more prompt in their appearance but are otherwise entirely similar to those produced by opium or laudanum. The medicinal dose of morphia, or its acetate, muriate, or sulphate, is *one-sixth* of a grain. Death has been caused by *one* grain of the muriate, taken in divided doses over a period of six hours,(*x*) and by one and one-third of a grain within four hours.(*y*) The former dose was equal probably to six grains of opium. It was for poisoning with the acetate of morphia, that Castaign, who had formerly been a pupil of Orfila, was, in the year 1823, tried and executed in Paris. He was convicted less upon the medical than the circumstantial evidence offered, since, with the most ingenious refinement of cruelty, he had administered tartar emetic to his victim for the purpose of getting rid of any of the poison which might have remained in the stomach.

(*x*) Ed. Month. Journ., Sept. 1846. (*y*) *Vide* § 695.

The medical testimony could only show that the symptoms and post-mortem appearances were not opposed to the supposition that morphia was the cause of death.

§ 550. 7th. *Chemical examination.*—Opium is easily recognized by its familiar physical properties. As, however, it is seldom presented in a pure state for examination, but mingled with some form of organic matter, these properties can seldom enable us to distinguish it. It is important to bear in mind, as Casper has remarked, that the ultimate chemical constituents of opium are identical with those of our food, and hence, may be so entirely digested that no trace of the fatal poison can be detected by chemical means in the body of its victim. It is necessary to describe first the properties and tests of morphia and meconic acid, since it is to these constituents that opium owes principally its poisonous qualities, and the chemical analysis is therefore directed to their separation from the substances examined.

§ 551. 8th. *Morphia.*—Pure morphia crystallizes in very small prisms, belonging to the rhombic system. They are nearly insoluble in water, and have a bitter taste. Boiling water dissolves a little more than one four-hundredth part of morphia; it is nearly insoluble in ether, but readily soluble in sulphuric, muriatic, or acetic acid. The following are some of the chief characteristics of morphia, as enumerated by Pereira:—

1. *Nitric acid* reddens morphia, or its salts (the chlorate excepted, according to Dumas), and forms with them an orange-red solution, which is much darkened by an excess of ammonia, and which becomes yellow after a little time. *Fallacies.*—Nitric acid produces a red color with several other bodies, as brucia, commercial strychnia, several volatile oils (as oil of pimento and oil of cloves), some resinous substances, etc.

2. *Iodic acid* is deoxidized by morphia, iodine being set free. Hence, when this alkali is added to a solution of iodic acid, the liquor becomes reddish-brown, and forms a blue compound (*iodide of starch*) with starch. *Fallacies.*—Sulphuretted hydrogen, sulphurous acid, phosphorous acid, sulphocyanide of potassium, sulphosinapisin, and some other agents have a similar

effect on iodic acid. Of course if the morphia be pure, these fallacies have no application.

3. Neutral sesquichloride of iron, dropped on crystals of morphia, renders them blue. It is indispensable to prepare a solution of this salt or of the persulphate of iron sufficiently concentrated and with as small an amount of acid as possible. The solution is thus prepared: Introduce into a small receiver a mixture of one part sulphuric acid, pure (at 66°), and of one and a half parts of distilled water, saturated by an excess of hematite (sesquioxide of iron), finely powdered, keeping the receiver in a water-bath of boiling water. As soon as the liquid has become saturated with the sesquioxide of iron, it is thrown upon a filter and the clear solution received in a small flask. To produce the blue coloration, a small quantity of morphine is dropped upon a drop of the metallic solution, and stirred about with a small glass rod, when immediately the blue color appears. This is a very delicate test. (Tardieu) An excess of acid, a degree of heat above 122° F. (50° C.), or the presence of organic matter will prevent the production of the blue color. *Fallacies.*—Tannic and gallic acids, with a little water, and infusion of cloves or pimento, also form blue compounds with sesquichloride of iron. Dr. Carson adds to the above statements—"if, to a mixture of morphia and concentrated sulphuric acid, a drop of bichromate of potash be added, green oxide of chrome is set free."(*z*)

These color-tests should always be performed upon a clean white porcelain capsule, or upon a clean white piece of porcelain.

§ 552. The salts of morphia present the same reactions as above, and, provided they are soluble in water, undergo the different decompositions common to nearly all the salts of the alkaloids. Thus they give white precipitates with tannin, bichloride of mercury, brown with an aqueous solution of iodine and iodide of potassium, a yellow clotted precipitate with the bichloride of platinum (this precipitate softens by boiling, becoming resinoid), clear yellow by phospho-molybdic acid, etc. This last reagent being very sensitive, the process of pre-

(*z*) Mat. Med., Am. ed., ii. p. 1061.

paring it is here given: A yellow precipitate from molybdate of ammonia, to which nitric acid has been added, is obtained by phosphate of soda, and well washed; this precipitate is then delayed in water and heated with carbonate of soda till perfectly dissolved; then the solution is evaporated to dryness and calcined to drive off the ammonia. If after the calcination only a partial reduction has been accomplished, the mass is again calcined, after having been sprinkled with nitric acid. Afterwards heat the calcined mass in distilled water, add enough nitric acid to make the solution strongly acid, and a sufficient quantity of water to make ten parts of the liquid to one of the saline substance. In this way a golden-yellow liquid is obtained, which should be kept away from ammoniacal vapors.

The principal salts of morphia (the sulphate, acetate, and the hydrochlorate) are crystalline, soluble in water and alcohol, insoluble in ether, and possess a disagreeable bitter taste. One hundred parts of the last correspond to eighty parts of morphia (crystalline). The other derivatives of opium are meconic acid, codeine, narcotine, narceine, thebaine (paramorphine), papaverine. Thebaine is supposed by M. Cl. Bernard to possess the strongest convulsive action of all the alkaloids of opium. The most notable poisoning by the acetate of morphine is that by Castaign, in June, 1823. He was, however, convicted by circumstantial evidence.

§ 553. *Meconic acid.*—The characteristics of this acid are as follows: 1. It reddens the neutral sesqui-salts of iron; the red color is destroyed by alkalies, protochloride of tin, and nitric acid, assisted by heat. This, which is the most reliable test for meconic acid, is still also open to objection. Thus sulphocyanic acid produces a similar red color with the persalts of iron. The force of this objection is derived from the fact that sulphocyanic acid is naturally sometimes present in the saliva. Christison, indeed, states, that "it is seldom possible to procure a distinct blood-red coloration from the saliva, except by evaporating a large quantity to dryness, and redissolving the residue in a small quantity of water;" but Pereira dissents from this statement, and says, that in a large majority of cases, he has found saliva distinctly and unequivocally reddened by the

persalts of iron. He says, moreover, that he has several times obtained from the stomach of subjects in the dissecting-room, a liquor which reddens the salts of iron. We believe that the opinion of chemists now, is, in general, in accordance with the statements of the last-named author. The means of distinguishing the sulphocyanate from the meconate is to be found in the action of chloride of gold, or of corrosive sublimate, since, if a few drops of a solution of either of these reagents be added to the red liquid, the color, if due to sulphocyanic acid, will be immediately destroyed. Further, the liquid may be diluted and a few drops of a solution of the acetate of lead added; a precipitate falls which is either meconate or sulphocyanate of lead. The former is insoluble, while the latter is quite soluble in acetic acid.(*a*)

§ 554. 9th. *Detection of opium or its constituents in organic mixtures.*—Various processes have been recommended for this purpose. All of them require delicacy and skill in manipulation, but, from the comparatively infrequent opportunity of discovering any trace of opium in the body, we shall cite only the two most recent and probably the best.

The following is the process recommended by M. Flandin for the detection of the vegetable poisons in organic mixtures: "Mix the matter in question in the proportion of 12 to 100 of its weight of anhydrous lime or barytes, and rub them down together in a mortar; heat to perfect dryness, but not to exceed 212° F.; treat the powdered matter, at least three times successively, with anhydrous, boiling alcohol, and, on cooling, filter. The liquid thus obtained is almost without color; it contains the principle or principles sought for, and also fatty or resinous matter soluble in alcohol. Distil or evaporate slowly by alcohol and treat the dry and cold residuum with ether so as to remove the fatty matters. If the principle sought for is insoluble in ether (as morphia, strychnia, brucia), it remains isolated in the liquid and can be separated by filtration and even simple decantation. If it be soluble in ether,

(*a*) Taylor on Poisons, p. 503. For an elaborate account of the nature of the tests for morphia and meconic acid, the reader is referred to Dr. Taylor's work.

then the principle must be obtained by a special solvent of the organic bases, as, for example, acetic acid, and precipitate the base finally by ammonia. The chemist in charge must adapt his tests to the supposed substance. I submit only the general method. I have mixed with 100 grains of animal matter a grain, or even less, of morphia, strychnia, and brucia; and operating on the mixture, in the manner described above, have collected from the mixture ponderable portions of the above poisonous principles. Again, I have added to the animal matters rough opium, laudanum, a decoction of nux vomica, false angustura, etc., and have isolated by this method the poisonous principles perfectly pure. In order to satisfy myself of the satisfactory application of it to legal medicine, I have poisoned animals with the smallest required doses of opium, morphia, nux vomica, strychnia, false angustura, and brucia, and it was always possible to detect the poison in the contents of the stomach and intestines, and sometimes, indeed, in the organs to which it had been carried by absorption. In a special experiment I mixed two parts and a half of morphia with one hundred of meat, and abandoned the compound to putrefaction for two months. At the end of that time, using the method above described, I discovered a notable proportion of morphia."(*b*)

§ 555. A still more elaborate, and perhaps more perfect, process, is detailed by Professor Stas, of Brussels, justly distinguished for his admirable reports in the Bocarmé case: "The method I now propose for detecting the alkaloids in suspected matters, is nearly the same as that employed for extracting those bodies from the vegetables which contain them. The only difference consists in the manner of setting them free, and of presenting them to the action of solvents. We know that the alkaloids form acid salts, which are equally soluble in water and alcohol; we know also that a solution of these acid salts can be decomposed, so that the base set at liberty remains either momentarily or permanently in solution in the liquid. I have observed that all the solid and fixed alkaloids above enumerated, when maintained in a free state and in solution,

(*b*) Am. Journ. of Med. Sci., Oct. 1853, p. 542, from the Comptes Rendus.

in a liquid, can be taken up by ether when this solvent is in sufficient quantity. Thus, to extract an alkaloid from a suspected substance, the only problem to resolve consists in separating, by the aid of simple means, the foreign matters, and then to find a base, which, in rendering the alkaloid free, retains it in solution, in order that the ether may extract it from the liquid. Successive treatment by water and alcohol, of different degrees of concentration, suffices for separating the foreign matters, and obtaining in a small bulk a solution in which the alkaloid can be found. The bicarbonates of potash or soda, or these alkalies in a caustic state, are convenient bases for setting the alkaloids at liberty, at the same time keeping them wholly in solution, especially if the alkaloids have been combined with an excess of tartaric or of oxalic acid." To put in practice the principles thus explained, the following method is proposed. "I suppose that we wish to look for an alkaloid in the contents of the stomach or intestines; we commence by adding to these matters twice their weight of pure and very strong alcohol; we add afterwards, according to the quantity and nature of the suspected matter, from thirty to forty-five grains of tartaric or oxalic acid—in preference, tartaric; we introduce the mixture into a flask, and heat it to 160° or 170° Fahrenheit. After it has completely cooled it is to be filtered, the insoluble residue washed with strong alcohol, and strained, and the filtered liquid evaporated *in vacuo*, or it may be exposed to a strong current of air at a temperature of not more than 90° Fahrenheit. If, after the volatilization of the alcohol, the residue contains fatty or other insoluble matters, the liquid is to be filtered a second time, and then the filtrate and washings of the filter evaporated in the air-pump till nearly dry. If we have no air-pump, it is to be placed under a bell-jar, over a vessel containing concentrated sulphuric acid or quicklime. We are then to treat the residue with cold anhydrous alcohol, taking care to exhaust the substance thoroughly; we evaporate the alcohol at a low temperature, or better still *in vacuo*, spontaneously. We now dissolve the acid residue in the smallest possible quantity of water, introduce the solution into a small

test-tube, and add little by little pure powdered bicarbonate of soda or potash, till a fresh quantity produces no further effervescence of carbonic acid. We then agitate the whole with four or five times its bulk of pure ether, and leave it to settle. When the ether swimming on the top is perfectly clear, then decant carefully about two cubic centimetres of it into a small glass capsule, and leave it in a *very dry place* to spontaneous evaporation." If the suspected alkaloid is solid and fixed, there may or may not be a residue containing it. If there is, a solution of caustic potash or soda should be added to the liquid, and agitated briskly with ether. "This dissolves the vegetable alkaloid, now free, and remaining in the solution of potash or soda. In either case, we exhaust the matter with ether. Whatever be the agent which has set the alkaloid free —whether it be the bicarbonate of soda or potash, or caustic soda or potash—it remains, by the evaporation of the ether on the side of the capsule, as a solid body, but more commonly a colorless milky liquid, holding solid matters in suspension. The odor of the substance is animal, disagreeable, but not pungent. It turns litmus paper permanently blue."

In order now to obtain the solid alkaloid in a crystalline state, the foreign matters, with which it is generally solid, must be first removed. Prof. Stas, to accomplish this purpose, adds a few drops of water feebly acidulated with sulphuric acid, to the contents of the capsule, and thus forms an acid sulphate, which should be carefully decanted, evaporated *in vacuo* or over sulphuric acid, the residue treated with pure carbonate of potash, and the alkaloid dissolved out by absolute alcohol. The evaporation of the alcohol gives the alkaloid in crystals. By this process, Prof. Stas has isolated all the important fixed alkaloids previously mixed with foreign matters.(*c*) For the mode of obtaining the volatile alkaloids, the reader is referred to the article NICOTINA. L. V. Uslar and J. Eadman (*d*) have proposed an improvement upon the Stas process as concerning the fixed alkaloids, whilst Stas's method is the best for

(*c*) Am. Journ. of Pharmacy, Jan. 1853.

(*d*) Annal d. Chemie u. Pharm., 120, p. 121; and 122, p. 360.

the volatile alkaloids. This modification is the substitution of amylic alcohol instead of ether.

§ 556. Very many if not all the alkaloids can be separated from organic mixtures by dialysis. This process is founded on the principle suggested by Graham, that crystalloids possess the property of passing through porous bodies, membranes, etc., and thus can be separated from animal matters.

This is the method recommended by Wurtz:(*e*) "The vegetable alkalies belong to this class, and can be separated quite promptly from suspected matters, and in a sufficiently pure state to allow of their being recognized by the ordinary reagents. In addition, this method has the advantage of not altering the suspected matters by heat or otherwise, and of not introducing any foreign substance, and in case of want of success, the ordinary methods can afterwards be employed."

§ 557. For some time it was hoped that Graham's method of dialysis would serve as a substitute for the much longer and more intricate method of destroying organic matter by sulphuric, nitric, tartaric acid, lime, etc., which had been, and still is, in vogue in accurate estimations of poisons mixed with organic matters. Tardieu(*f*) does not recommend this method very highly. He relates the following experiment: "The organs of a dog which had been poisoned by (20 centigrammes) about three grains of arsenious acid reduced by boiling into a pulpy mass, and placed for twenty-four hours in a *dialyzer*, allowed but a very small quantity of arsenic to become diffused, as a metallic ring was with great difficulty obtained, and but a few little spots were produced in Marsh's apparatus; whilst, on the contrary, the boiled liquid which had been left inside the *dialyzer*, treated by the usual method of carbonization, gave five very brilliant rings, and covered a porcelain saucer with several spots. Two analogous experiments tried with the organs of two dogs, one of which had been poisoned by a mercurial salt and the other by a salt of copper, gave results equally unsatisfactory. In those cases in which the poison has almost entirely disappeared from the organs, or can

(*e*) Dict. de Chimie pure et appliquée, 1870, article Alkaloïdes.
(*f*) Op. cit., p. 103.

be found only in minute quantity, dialysis would accomplish only the greater embarrassment in its recovery or of its separation in too incomplete a manner to be useful in the investigation. In brief, this method has not the power of rendering those services to legal medicine which had been expected of it."(*g*)

However, as the method of dialysis is not destructive, the chemical expert runs no risk of compromising the success of his work by the application of this process in the commencement of his analysis; provided, if he obtain no satisfactory result, he should resort to the other methods of analysis so well known in chemistry. This is the more especially true when it is remembered that no foreign element is introduced into the organic mixture by the use of dialysis.

II. *Hydrocyanic Acid, or Prussic Acid.*

§ 558. 1st. *Qualities.*—The extreme energy of this poison in small doses is well known. The medicinal acid directed by the United States Pharmacopœia contains two per cent. of pure anhydrous acid. Very nearly the same proportion exists in the formulas of the British pharmacopœias. Scheele's acid, for medicinal use, should contain five per cent. of real hydrocyanic acid, but as sold it is said usually not to exceed the strength of two per cent. The dilute hydrocyanic acid is a transparent, colorless, volatile liquid.

Its *taste* is described by Dr. Christison as acrid and pungent, and by others as hot or bitter; but it is probable, as remarked by Dr. Taylor, that the taste may be unperceived, when the dilute acid is taken in a fatal dose, concealed in porter or medicine.

Its *odor* is popularly supposed to resemble that of bitter almonds, but this notion is incorrect. It may have something of this odor, sufficient perhaps to recall it, and this peculiar

(*g*) Dr. Jul. Otto, in the third edition of his justly celebrated work (1867) on toxicological research, affirms that certain metallic compounds, such as the corrosive sublimate, enter into combination with the proteine substances, and that the sulphides do not pass through by dialysis, and that in all such cases it is necessary to examine the substance left in the dialyzer.

smell may be recognized by some persons and not by others, but the impression usually made by it is indistinct, with the exception of a peculiar involuntary constriction of the fauces. The character of the odor is an important consideration in cases of supposed poisoning by prussic acid. If distinctly recognized by more than one person about the mouth of the deceased, or upon opening the body, it may afford strong reason for supposing that death was caused by this agent. But, as will be presently seen, this evidence is not obtained in every case.

§ 559. 2d. *Symptoms.*—The rapidity with which this poison acts upon the system hardly allows of the observation of successive symptoms. Where insensibility is not immediately produced, it is preceded by faintness, giddiness, loss of muscular power, and sometimes by convulsions. In other cases, the patient being found insensible, it is impossible to know the previous symptoms. When seen at this time, the eyes are fixed and glistening, the pupils dilated and unaffected by light, the limbs flaccid, the skin cold, and covered with a clammy perspiration; there is convulsive respiration at long intervals, between which the patient appears lifeless; the pulse is imperceptible, and involuntary evacuations occasionally take place. The respiration is slow, deep, gasping, and sometimes heaving or sobbing. This description, which is applicable to the greater number of cases, we have borrowed from Dr. Taylor. It should be added, that there is usually rigidity of the jaws, which has sometimes effectually prevented the administration of antidotes.

§ 560. 3d. The *period at which death takes place* is usually within an hour, seldom indeed exceeding three-quarters of an hour. A man drank from a phial containing prussic acid, while embracing his wife; he died in fifteen minutes.(*h*) Seven epileptic patients, who were accidentally poisoned with this acid, died in convulsions within three-quarters of an hour.(*i*) In most cases, however, death occurs in a few minutes; and, if life be prolonged for a period of three-quarters of an hour, recovery may take place. The rapidly fatal character of this

(*h*) Pharm. Journ., Aug. 1851. (*i*) Orfila, vol. ii. 286.

poison is, indeed, one of its most striking features. From experiments upon animals, it was supposed at one time that prussic acid was, necessarily, almost immediately fatal. Animals, poisoned by it, die within a few seconds. In man, however, although the symptoms often commence in the act of swallowing, they may also not be perceived for one or two minutes.

§ 561. Upon this fact depends often an important question, bearing upon the voluntary or homicidal nature of the poisoning, since it may become evident from circumstantial evidence, that the deceased has retained consciousness and voluntary power for a certain length of time after swallowing the poison. In Mr. Burnam's case, mentioned further on, insensibility did not occur for two minutes after the poison was swallowed, and that in the largest dose yet recorded. In the case of a girl, aged seventeen, the servant of a chemist, who was seen by the reporter when already insensible, the retention of consciousness for a short period was proved by circumstantial evidence. In turning up the feather bed, after the body had been removed from it, a prussic acid bottle, with the stopper in, was found between it and the mattress, near the centre; it contained about eight drops of the acid. The girl's mistress stated, that about twenty minutes after the girl had left her, she was proceeding up stairs to bed, when, in passing the girl's room door, she heard a moaning noise; she entered the room, and found her lying in bed, with her clothes on, and the bedclothes drawn up to her face, apparently "gasping for breath." She instantly gave the alarm. "The evidence adduced proved, as far as *could* be proved, that she had swallowed an ounce of the acid, re-corked the phial, thrust it to full arm's length between the feather bed and the mattress, got into bed, and then drew the clothes over her body, and there appeared to have been no convulsions."(*j*) Dr. Sewell reports, in the same journal, the interesting account of a gentleman who swallowed seven drachms of the medicinal acid, equal to twenty-one grains of Scheele's acid. It was proved that after taking the poison he had walked from the table in the middle of the room to the

(*j*) Boston Med. and Surg. Journ., vol. xxxii. p. 528. Leithead.

door, unlocked it, called for assistance, and then, returning to a sofa in the room, stretched himself upon it. Here he was found lying as if in a profound slumber, his legs crossed, his arms by his side, and his eyelids firmly closed. The eyes were more brilliant than during life, and continued so until the next day. His face was livid, and the lips very blue; the muscles were all relaxed.(*k*) A young man swallowed, in his bedroom, a dose equivalent to 2.54 grains. He then descended thirty steps, and walked about twenty paces, before he became powerless. He was endeavoring to open the front door of the house to go out, when he suddenly fell. The only symptoms observed by a person present were, that "he threw his arms about, and made a noise in breathing, fetching it hard; he very soon became still."(*l*) A case which is characterized by Dr. Taylor as one of the most extraordinary on record in this respect, is that related by Mr. Godfrey: "A gentleman aged forty-four swallowed, it was supposed, half an ounce of prussic acid (strength not stated), but certainly a quantity sufficient to destroy life. After taking it from the bottle, he walked ten paces to the top of a flight of stairs, descended the stairs, seventeen in number, and went to a druggist's shop at forty-five paces' distance, where he had previously bought the poison, entered the shop, and said, in his usual tone of voice, 'I want some more of that prussic acid!' He then became insensible, and died in from five to ten minutes after taking the poison." There were no convulsions.

Such cases as these (and more might be quoted) fairly prove the untenable nature of the notion, that any acts indicative of design, committed after the poison had been swallowed, cannot be attributed to the deceased. Many simple acts, like those noted, can be easily performed in a very short space of time, and scarcely take anything away from the fearfully rapid character of this poison.

Another fallacy, derived from the result of experiments on animals, is the supposition that death from prussic acid is always preceded by a shriek! There is no case in the human

(*k*) Ibid., vol. xxxvii. p. 330.

(*l*) Lowe, Guy's Hospital Rep., 1846, p. 490.

subject which attests any such fact; on the contrary, in the vast majority of cases, there are neither general convulsions, as is common in animals, nor any unusual cry; but, on the contrary, death comes on in a placid manner, the patient passing away without a struggle. The convulsions which were observed in the seven epileptic patients, already referred to, may, with some probability, be referred to their constitutional predisposition. In a case of suicide by a dose equivalent to eight grains (reported by Dr. J. G. Fleming), the appearance of the body was most strikingly like life, even the natural color had not left the cheek, the features were composed, and the limbs relaxed. There evidently could have been no convulsions (*m*)

§ 562. 4th. The *smallest quantity* of anhydrous prussic acid capable of destroying life has so far, from actual observation, proved to be about nine-tenths of a grain. This was the amount which destroyed a woman mentioned by Mr. Hicks.(*n*) Life was extinct in twenty minutes. This quantity is equal to fifty drops of acid of the strength of two per cent. Other cases have been reported in which most alarming symptoms ensued from smaller doses.(*o*) In any case in which it appears that death has resulted from a small quantity, it is highly important, if we would avoid errors, that the real strength of the acid should be ascertained by an analysis of the sample remaining.

§ 563. 5th. Instances of *recovery from very large doses* have been recorded. Dr. Christison has reported a case in which, with great difficulty, a gentleman was restored who had taken between a grain and a half and two grains of the anhydrous acid;(*p*) and, still more recently, Mr. W. H. Burnam communicated to the *Lancet* a very interesting history of the recovery of his father from accidentally taking a drachm of Scheele's acid, which was found, upon analysis, to contain 2.4 grains of anhydrous acid.(*q*) Mr. Nunneley, also, has reported a case of recovery from one grain and a third of an-

(*m*) Edinb. Monthly Journ., July, 1846.
(*n*) London Med. Gaz., xxxv. 896.
(*o*) *Vide* Taylor on Poisons. (*p*) Med. Gaz., 1850, 917.
(*q*) Brit. and For. Med.-Chir. Rev., April, 1854.

hydrous acid.(r) One curious fact, in relation to the size of the dose, should not be forgotten, viz., that a comparatively small dose will produce equally fatal results with a large one, it being highly probable, from the cases so far recorded, that all doses over one grain are capable of destroying life with equal certainty and rapidity. The limits of safety, in the use of prussic acid, are easily passed, and the formidable symptoms occasioned by it develop themselves with wonderful rapidity; hence, too great caution cannot be observed in its administration with remedial views in medical practice.

M. Regnauld relates the case of a young man who was poisoned by the *vapor* of prussic acid disengaged from a mixture of the ferrocyanide of potassium and sulphuric acid. The symptoms were those of asphyxia, rather than of the nervous prostration which usually accompanies poisoning from the internal use of prussic acid.(s)

§ 564. 6th. *Post-mortem appearances.*—The face is either livid or pale; the lips and nails blue; and the skin of the neck, back, and shoulders much discolored. The jaws are firmly closed; the muscles of the hands and feet contracted, and cadaveric rigidity comes on sooner and is more perfect than usual. The eyes have a peculiar brilliant and glistening appearance, the pupils are widely dilated, and foam is sometimes seen about the mouth. Evidence of involuntary evacuation of the bladder and rectum is not unfrequently observed. The veins of the brain are found turgescent, and the lungs are congested with a very dark-colored blood. Orfila says that the mucous membrane of the air-passages has generally a dark-red color, which cannot be removed by washing, and the bronchial tubes are filled to their extremities with a bloody froth. The heart presents nothing abnormal. The mucous membrane of the stomach is, in perhaps the majority of cases, highly reddened, and this deepening of color may extend for some distance into the intestinal tube. In a case reported by Jochner, and in a few others, a chocolate-colored fluid had been found in the stomach. The blood is generally dark and fluid,

(r) Taylor.

(s) Brit. and For. Med.-Chir. Rev., Oct. 1853, p. 561.

sometimes also of a purplish color. It will readily be seen how insignificant are the pathological alterations found in those who have been killed by prussic acid. There is no one of the appearances here noted which may not be met with in death from many other causes, and especially in sudden death by some mode of asphyxia. The peculiar mottled and ecchymotic appearance of the lung tissue, the engorgement of both ventricles and sometimes of both auricles with dark fluid blood, the congestion of vessels of brain and spinal axis (Tardieu) mentioned by some authorities, are probably due to the asphyxia which the majority of cases of intoxication by this drug produces. Certain experiments (*t*) performed by the editor of the third edition of this work would seem to prove not only this point, but also that rapid and early post-mortem muscular rigidity would follow the majority of deaths which occur suddenly to persons previously in full health and muscular activity. In these experiments upon the intoxication of animals by prussic acid, artificial respiration prevented convulsions and certain post-mortem appearances usually attributed to this poison.

§ 565. The only circumstance which is at all deserving of attention, and which merits a separate consideration, is the presence or absence of the odor of prussic acid. It may be at once stated that where this odor is unequivocally detected, the evidence is satisfactory, since it is of so peculiar a character as not to be readily mistaken for anything else. Unfortunately, however, it is not always discovered, even in well-attested cases of poisoning by this substance. The odor is sometimes observed about the mouth and nostrils of the deceased, and is not perceived in the stomach. This was the case, in an instance reported by Jochner, of a young man who committed suicide by this poison. On the other hand, the stomach may exhale the odor of prussic acid and none be perceived about the mouth or in the room. This was noted in the case reported by Mr. Hicks, in which, moreover, the examination of the body was not made until *ninety* hours after death. On opening the chest, the odor was more plainly perceived than in any other

(*t*) *Vide* London Practitioner, April, 1872, p. 197.

part of the body, and the fluid contained in the stomach smelt very strongly of prussic acid.(*t*) In none of the epileptic patients before mentioned was the odor of prussic acid discovered in any part of the body. The inspection was made twenty-four hours after death. Dr. Christison's case of recovery from a large dose may be referred to here, as corroborative of these facts; the first liquid drawn from the stomach by the tube which he introduced, gave indications of the presence of prussic acid, on analysis, but not by any peculiar odor, although there was none other by which it might have been concealed. The stomach of Sarah Hart, poisoned by Tawell, had no odor of prussic acid, yet one grain of anhydrous acid was obtained, by distillation, from its contents, consisting partly of apple pulp. In the greater number of cases, however, there can be no doubt that it is readily distinguishable, since in some it has been so strong as to seriously affect the bystanders. The circumstances which cause these singular variations have not been thoroughly investigated. It is supposed, very naturally, that the length of time the person has survived after taking the poison, and the interval elapsing between death and the inspection of the body, must, as well as the dose, have an influence upon the preservation of the odor. But it is evident that these conjectures are not entirely satisfactory, since not only has the odor been detected after as long an interval as seven days, but, on the other hand, it has not been detected even where the presence of the acid has been demonstrated by chemical analysis. It is probable that in these cases it may have been fixed by a base.

§ 566. Hydrocyanic acid may be obtained from many vegetables, particularly those belonging to the sub-orders Amygdaleæ and Pomeæ;(*u*) as from bitter almonds, apple-pips, the kernels of peaches, apricots, cherries, plums, and the flowers of the peach, and cherry-laurel, and from the bark of the wild cherry, and the root of the mountain-ash. Prussic acid does not exist ready formed in these plants, but is the result of the reaction of water upon amygdalin. Hence, if any of the above

(*t*) Med. Gaz., xxxvi. 460. (*u*) Pereira.

substancces are found in the stomach, the question may arise whether the indications of the presence of prussic acid are due to them or to the acid swallowed as such. The only manner in which doubt arising from this circumstance can be satisfied, is the obtaining, by chemical analysis, a larger quantity of the acid from the contents of the stomach, than these substances could afford. It is extremely improbable that death should result from the ingestion of any of these articles except in such a large quantity as to obviously preclude the idea of prussic acid in substance having been taken.

It has been stated that this acid may be produced spontaneously from unsound cheese; but Dr Taylor was unable, by experiment upon numerous samples of decayed cheese, to find any evidence of it. The notion, also, that it may be a spontaneous product of animal decomposition, is timidly advanced by Orfila, but has not yet received the necessary confirmation. It is also said to be produced by the action of nitric acid on alcohol. This fact was clearly ascertained by M. de Claubry, who observed the serious effects of the vapor upon the health of the workmen engaged in the manufacture of hyponitrous ether.(*v*)

§ 566*a*. While these objections must be allowed their full force in cases where their applicability can be shown, it by no means follows, where no chemical process further than mere distillation is employed, and where none of the organic matters above mentioned are found in the stomach, that the distinct evidence of the presence of prussic acid, by odor and by the simple chemical reactions to be presently noticed, ought not to be perfectly satisfactory. Moreover, if the mode of death be known, these objections will fall away of themselves. If, however, none of the circumstances preceding death can be ascertained, and neither the odor of prussic acid nor its reactions with the established tests be recognized, it may certainly become a question of serious import, whether the traces of it found afterwards may not be due to some other cause than its ingestion into the stomach. Thus, if the contents of the stomach be subjected to distillation *with an acid*, it may pos-

(*v*) Ann. d'Hyg., 1839, ii. p. 350.

sibly happen that the sulphocyanide of potassium, which sometimes exists in minute traces in the saliva, may be decomposed, and evidence of prussic acid be thus obtained.(*w*) For the value of these objections, we must refer the reader to the more detailed treatises on Poisons, especially to those of Drs. Christison and Taylor, and to Orfila's *Médecine Légale* and *Toxicologie.*

§ 567. *Bitter almonds.*—A lad of fifteen, the son of a wholesale grocer, got access to a cask of bitter almonds, and consumed a large quantity of them with sugar. After a time, but how long is not known, he felt a pleasing sensation, then became suddenly giddy, fell down, and lost his consciousness and recollection. He was found lying insensible near the cask. Ammonia and carbonate of potash were successively administered, and the stomach pump employed. By these means he was much relieved. Emetics were then given, and he threw off, in the course of half an hour, as much as *eight ounces, Troy,* of bitter almonds.(*w*[1])

§ 568. 7th. *Chemical tests.*—The best tests for hydrocyanic acid are equally adapted to its detection in its simple state and mixed with organic liquids. In the latter case, if the vapor cannot be detected by the tests, the liquid must be filtered and reduced by distillation, the acid being fixed by caustic potash or nitrate of silver.

§ 569. (1) *The iron test.*—This is the surest and by far the most rapid of the tests known in chemistry for the recovery of prussic acid. It is founded upon the formation of prussian blue, and the following is the method recommended by Tardieu.(*x*) Make a mixture of two solutions, one of a protosalt of iron and the other of a sesquisalt of the same base (the sulphate or chloride. Add a few drops of the mixture to the suspected liquid and agitate; no precipitate should appear. Then add to the liquid thus treated a quantity of a solution of potassa or caustic soda sufficient to turn litmus paper clearly blue (this shows when the solution has become alkaline); an immediate

(*w*) The amount of prussic acid in this case would be *very* minute.
(*w*[1]) Ed. Month. Journ., Oct. 1850, p. 379.
(*x*) Op. cit., p. 1040.

black or greenish precipitate appears, which, if no prussic acid exists in the suspected liquid, is composed exclusively of a mixture of protoxide and sesquioxide of iron; whilst if there should be contained in the liquid any prussic acid there would appear, mixed with these two bodies, a small proportion of prussian blue (an intermediate cyanide of iron). If the first precipitate (black or green) only occurs, the addition of a slight excess of hydrochloric acid will instantly dissolve the two oxides, and will make a very clear solution. If, on the contrary, the liquid contains prussic acid, the addition of hydrochloric acid will have the effect of bringing out more beautifully the intense color of prussian blue. In this last case, however, it must be observed that the yellow color of the liquid, due to the presence of a dissolved sesquisalt of iron, may be so intense as to momentarily mask the color of prussian blue, and to give to it the appearance of a greenish precipitate (a mixture of the two colors yellow and blue). This is an important cause of error, especially when a minute quantity of the prussic acid is present. A better method would consist in this case, in order to make the true color of the precipitate apparent, in throwing the disturbed liquid upon a small "Berzelius filter paper," and thus allow all the liquid portion to drain off, and then wash the precipitate with a small quantity of water slightly acidulated. If prussian blue is then present the color of this body would appear brilliantly exposed to view upon the white ground of the paper. Carson observes that this test will detect hydrocyanic acid when it is mixed with common salt, or other chlorides which interfere with the reaction of nitrate of silver. It is, on the whole, a delicate test when properly employed; but a frequent cause of failure in its application is the addition of too much potassa, or of the iron salt.

§ 570. The *vapor* of prussic acid may also be detected by this test, by means of the following expedient: Put a drop of the solution of potash in a small white saucer, and invert it over another containing a portion of the suspected liquid. After two or three minutes, or more if the acid be much diluted, remove the upper saucer and drop on the potash a drop of the solution of the green sulphate of iron; agitate and expose to

the air for a few seconds; add one or two drops of dilute muriatic acid, to dissolve the surplus oxide of iron, and if hydrocyanic acid is present, a trace of prussian blue will appear. This test may be conjoined with the silver test, both in its application to the liquid and to the vapor, for if the cyanide of silver formed in that test be decomposed by muriatic acid, prussic acid being liberated will of course give the reactions just described.

§ 571. (2) *The silver test.*—The nitrate of silver causes, in a liquid containing prussic acid, a clotted white precipitate of the cyanide of silver, which is known by its solubility in boiling nitric acid. This property distinguishes cyanide of silver from chloride of the same base, the latter being insoluble in boiling nitric acid. It is insoluble in cold nitric acid, and also in water; though it is quite soluble in ammonia. If sufficient quantity of nitrate of silver be added, all the prussic acid will be thrown down as cyanide of silver (thus removing the odor of prussic acid). If the cyanide of silver is heated in a small straight tube closed at one end, a very strong and penetrating odor is evolved by the decomposition of the salt; the gas evolved burns, when lighted, in contact with the air, presenting a beautiful reddish-purple color, having a green tinge on the outside of the flame.

In a solution of nitrate of the protoxide of mercury, free prussic acid will precipitate the metallic mercury in the form of cyanide of mercury. Added to a solution of the bichloride of mercury, the prussic acid causes no disturbance, but loses its odor completely.

The *vapor* of prussic acid may be detected also by the silver test. A watch-glass may be moistened with nitrate of silver, and inverted over a vessel containing this acid; very soon an opaque white film of the cyanide of silver forms upon the moistened spot. Dr. Taylor states that one drop of the officinal acid (containing less than $\frac{1}{50}$th of a grain of the anhydrous acid) produces speedily a visible effect.

M. O. Henry has also suggested the following method of determining whether the precipitate contains the cyanide of silver; from one-third to one-half of a grain of the precipitate should be boiled for five or six minutes in a small tube with

half its weight of chloride of sodium or potassium, and six or seven fluidrachms of distilled water. If the precipitate contains a cyanide, an insoluble chloride of silver and a soluble cyanide of sodium or potassium will be formed. The latter being filtered, treated with a small quantity of freshly prepared green hydrated oxide of iron, is heated again and filtered. It then contains a ferrocyanide of potassium or sodium, and, if treated by a salt of the sesquioxide of iron, gives a prussian blue color, and, if by the sulphate of the deutoxide of copper, a chestnut-colored precipitate.

M. Henry and H. Hubert have also proposed the following very satisfactory test. The cyanide of silver, having been prepared according to the method referred to above, and thoroughly dried, is introduced into a tube closed at one end, from five to seven inches long, and containing at its closed extremity about half the weight of the cyanide in iodine. On heating this end of the tube very gently, beautiful snow-white crystals of iodide of cyanogen are deposited upon the cool portions of the tube.(*y*)

§ 572. (3) *The sulphur, or Liebig's test.*—This test was first proposed by Liebig, and is the most delicate one yet discovered, as it will not only indicate the presence of prussic acid when no *odor* can be perceived, but when the other tests have failed to detect it. Dr. Taylor says that he detected clearly as small a quantity as the 0.3930th of a grain, and that in an experiment in which ten drops of a liquid containing only one 473d part of a grain of anhydrous prussic acid, produced the characteristic reaction with hydrosulphuret of ammonia in five minutes.

§ 573. Dr. Taylor(*z*) says: "The iron and silver tests may be applied first, and these should be followed by the sulphur test, as the latter always contaminates the liquid to be tested. * * * Although we at present know of no vapor but that of prussic acid, which will thus affect the sulphur-test, it appears to me that we should not be justified in relying upon infinitesimal results, which admit of no kind of corroboration. The question is here much the same as in reference to the detection, by the

(*y*) Bull. de l'Acad. de Méd., xxii. 350. (*z*) On Poisons, p. 674.

process of Marsh, of minute traces of what is alleged to be arsenic, when the quantity is too small to be separated by Reinsch's process. The silver test cannot be relied upon for detecting small quantities of prussic acid in organic liquids or solids, unless the film of cyanide of silver is converted into sulphocyanate of ammonia. When, however, we have procured the colored results by the iron and sulphur tests, there can, it appears to me, be no reasonable doubt of the presence of the poison. With either result, separately, as applied to the vapor, there may be room for objecting to the conclusion that prussic acid has been certainly detected."

§ 574. The manner of applying the sulphur test is as follows: "If a small quantity of hydrosulphuret of ammonia (containing a little excess of sulphur) be added to a few drops of the solution of prussic acid, and the mixture be gently warmed, it becomes colorless, and, on evaporation, leaves sulphocyanate of ammonia, the sulphocyanic acid being indicated by the intense blood-red color produced on adding to the residue a solution of a persalt of iron; this color immediately disappears on adding one or two drops of a solution of corrosive sublimate. This test is very delicate, and it therefore requires some care in its application; thus, if the boiling and evaporation be not carried far enough, the persalt of iron will be precipitated black by the undecomposed hydrosulphuret of ammonia; and if the heat be carried too far, the sulphocyanate of ammonia may itself undergo decomposition and be lost."(*a*) "The great utility of the sulphur test, however, is in its application to the detection of the minutest portion of prussic acid when in the state of *vapor*. In this respect it surpasses any process yet discovered. In order to apply it we place the diluted prussic acid in a watch-glass, and invert over it another watch-glass, holding in its centre one drop of the hydrosulphuret of ammonia. No change apparently takes place in the hydrosulphuret; but if the watch-glass be removed after the lapse of from half a minute to ten minutes, according to the quantity and strength of prussic acid present, sulphocyanate

(*a*) The terms in the text, "hydrosulphuret of ammonia," and "sulphocyanate of ammonia," should more properly be sulphide of ammonium, and sulphocyanide of ammonium, or rhodanide of ammonium.

of ammonia will be obtained on gently heating the drop of hydrosulphuret, and evaporating it to dryness. With an acid of from three to five per cent. the action is completed in ten seconds. The addition of one drop of persulphate of iron to the dried residue brings out the blood-red color instantly, which is intense in proportion to the quantity of sulphocyanate present. When the prussic acid is excessively diluted, the warmth of the hand may serve to expedite the evolution of the vapor."(*b*) The tests for the *vapor* are equally applicable to organic mixtures and to the detection of the poison in the blood, secretions, or soft tissues.

§ 575. Buchner(*b*[1]) gives an account, in connection with the murder of the Countess Chorinsky, of the detection of prussic acid in the murdered woman. No odor of prussic acid could be detected in the blood, which remained in a fluid state for five days, and remained free from putrefaction for a considerable time. Some of the blood mixed with water was distilled; the first portions of the distillate evolved the vapor of prussic acid, easily recognized by its odor, and presented the usual reactions of prussic acid. Buchner considered the sulphur test of Liebig the most delicate. Prussic acid was detected even after fifteen days.

"Sohœnbein moistens filter-paper with fresh tincture of guaiacum, containing three or four parts resin, and, after drying, with a solution containing one-quarter per cent. of sulphate of copper. This paper is instantly rendered blue in the atmosphere of a twenty-litre vessel containing one drop of dilute prussic acid of one per cent."(*c*) An interesting case of suicide (Twichell) in which no odor of prussic acid could be detected at the post-mortem examination, was investigated by a committee appointed by the Philadelphia Pathological Society, who reported to that society May 13th, 1869.(*d*) The committee in their report have given an excellent review of recent investigations of poisoning by prussic acid, and for a complete

(*b*) Taylor on Poisons, p. 548.

(*b*[1]) Revue des Cours Scientifiques.

(*c*) Schwiez, Wochenschr., f. Pharm., and Am. Journ. of Pharmacy for Sept. 1849, p. 421.

(*d*) Am. Journ. of the Med. Sciences, Oct. 1869, p. 432.

account reference is made to this report. The committee attributed the absence of the odor of the agent to the fact that the acid combined with the oxyhæmatoglobulin (a certain coloring matter of the blood), which also is in combination with oxygen; this may also account for the peculiar bright-red color of the blood. "But though deprived of its odor the *cyanide of oxyhæmatoglobulin* is none the less fatal, and after death the odor (of prussic acid) is exhaled from the tissues."(*e*) "Lecorché and Meuriot also state that the blood in such cases resists decomposition longer than usual."(*f*) With regard to this question it must not be forgotten that the sense of smell in some persons is much more acute than in others, and again with some persons this sense is almost deficient.

§ 576. The spectroscope has been suggested as a means for determining the peculiar changes of the blood after prussic acid intoxication. It is too early yet to give any directions for examination by this instrument, nor have any results yet been attained to warrant its use as a reliable agent in the investigations of poisons in legal medicine. For an interesting memoir on this subject, reference is given to a paper by Victor Fumouze, "Les Spectres d'Absorption du Sang;"(*g*) also Stokes(*h*) gives an analysis of a paper by Preyer(*i*) on the absorption-spectra of blood and prussic acid, etc. Also in "Traité d'Histologie," etc., Frey, Spillman, et Ranvier, an appendix by the latter upon "Des Substances Colorées du Sang et de leur Analyse Spectrale."(*j*)

§ 577. It is important to remark here that it is in the tissues especially that prussic acid may be found, though no odor of the agent can be detected in the blood, and that when no suspicion of the poisonous agent is held by the chemical expert, he should, first of all, examine for this evanescent or volatile poison. Taylor(*k*) mentions the case of a dog's stomach which had been exposed to the air for twenty-four hours after death

(*e*) Ibid. from Preyer, in Glasgow Med. Journ., Nov. 1868, p. 74.
(*f*) p. 541.
(*g*) Paris, G. Baillière, 1871.
(*h*) Glasgow Med. Journ., 1868, p. 70.
(*i*) Die Blausaüre, Bonn, 1868. (*j*) Paris, F. Savy, 1871.
(*k*) Medical Jurisprudence, London, 1865, p. 802.

by prussic acid intoxication, and then thoroughly washed under a current of water, yielding the cyanide of silver in the course of chemical analysis.

§ 578. (4) *Detection after death.*—Notwithstanding the readiness with which prussic acid undergoes decomposition, it has been detected in the body after death. Rieckher detected it in the contents of the stomach by the sulphur test, twenty-four hours after death.(*l*)

Mr. West was able to detect it on distillation, by the odor and the silver and iron tests, *twenty-three* days after death, although no pains had been taken to insure its preservation.(*m*) In the following case it will be seen that it was detected after about the same period of time.

A young man of Tours having purposely poisoned himself with medicinal hydrocyanic acid of the twelfth degree, of which he appeared to have swallowed about twenty-five grammes, M. Brame was called upon, after the lapse of *three weeks*, for the purpose of trying whether it was possible to detect hydrocyanic acid in the body. He was able to detect and estimate a considerable quantity of this poison which had remained in the stomach. By the addition of neutral and pure nitrate of silver, there was formed an abundance of a flocculent and yellowish precipitate, which, well washed and dried under the air-pump, and then heated for a few seconds on a sand-bath, assumed a gray color. This precipitate was soluble in ammonia and cyanide of potassium. Decomposed hot with potassium, cyanide of potassium was formed, with which it was easy to obtain hydrocyanic acid and prussian blue. Suspended in water, and subjected to the action of a current of hydrosulphuric acid, it gave rise to a clear and limpid solution of hydrocyanic acid when the sulphuret formed had been separated by filtration. By means of hydrochloric acid hydrocyanic acid could be obtained from it of a very powerful odor, and the vapor of which formed a white precipitate in a solution of nitrate of silver; the precipitate was soluble in ammonia. The first precipitate, heated in a lamp, in a narrow tube closed at one end, gave hydrocyanic acid and a

(*l*) Canstatt's Jahresbericht für 1852, Bd. vii. p. 49.
(*m*) Prov. Med. Journ., July 23, 1845.

few drops of water, etc. This same precipitate, gently heated with caustic potassa, gave rise to no disengagement of ammonia.

In this case the hydrocyanic acid had remained in the stomach three weeks after burial. It did not appear to have entered into any chemical combination. There was a very considerable quantity of it, for, says M. Brame, "I was able to collect about 0.60 of cyanide of silver, or nearly 0.120 of hydrocyanic acid."(*n*) In the "Eaglesham" poisoning case it was detected in the stomach of the body which had been buried fourteen days;(*o*) and in a recent German case three weeks after death.(*p*)

§ 579. 8th. The essential *oil of bitter almonds* is most active as a poison, and has repeatedly been the cause of death. It is stated that in one year the daily papers of London furnished accounts of ten cases of poisoning by it. Dr. Maclagan, who has made some valuable observations respecting it,(*q*) states that the ordinary commercial essential oil of bitter almonds consists of a peculiar oil (hydruret of benzule), to which its peculiar aroma and pungency are due, associated with anhydrous prussic acid. The hydrocyanic acid can be separated from the hydruret of benzule without impairing the peculiar flavor of the oil, and yet leaving it comparatively innocuous. Much of the difference of opinion which has reigned as to this fact arises from the circumstances that by merely agitating the oil with a large excess of lime or caustic potash, and distilling it, the prussic acid is not sufficiently separated. A salt of iron should be employed, which fixes it more effectually. Dr. Maclagan made experiments upon dogs with the oil thus rectified, and found that when no trace of prussic acid could be detected by the iron test, it was not poisonous. The following are the most prominent of his conclusions: 1. That the poisonous action of the unrectified oil is essentially due to the hydrocyanic acid which it contains. 2. That the oil really free from prussic acid, in doses of a few drops,

(*n*) The Chemist, Feb. 1855, from Comptes Rendus, No. 20, Nov. 13, 1854, by M. Brame.

(*o*) Edinb. Med. Journ., iv. 163.

(*p*) Brit. and For. Med.-Chir. Rev., April, 1860, p. 531.

(*q*) Edinb. Month Journ., Jan. 1854.

does not act as a poison on animals generally. 3. That although the rectified oil, in doses of a drachm and upwards, does prove fatal to rabbits, yet that on dogs, whose organization renders them much better subjects for testing the probable effects of the substance on man, doses even so large as three drachms of the oil, entirely or nearly free from prussic acid, produce no other effect than a little vomiting, and do not cause death, or even dangerous symptoms.

The same results have in the main been obtained by other chemists, particularly Wöhler and Frerichs.

Why the deadly ingredient should be allowed to remain in it, if it can be so readily removed, it is not easy to understand. The placing of restrictions upon the sale of this and other articles of a pernicious character, for the purpose of flavoring or ornamenting articles of food, appears to us to be of still more urgent importance than any restraint upon the sale of arsenic and similar poisons, which cannot be employed except for destructive purposes. In the latter case means are readily found to obtain the required poison; while in the former, experience has shown that equal brilliancy of color and delicacy of flavor can be obtained from harmless substances as from the deadly poisons in universal and daily use in this country and England. Prussic acid is too potent a poison to be distributed to cooks and confectioners, disguised with the pleasant odor of bitter almonds; the most ordinary prudence and humanity would seem to demand that it should not be used thus freely and incautiously.

§ 580. The following are a few of the instances in which the oil of *bitter* almonds has produced fatal results:—

A child, eight and a half years old, took a teaspoonful of *ratafia*, containing seven drops of the oil of bitter almonds. She became immediately insensible, but had no spasms; the limbs were relaxed, the jaw, however, firmly closed; the eyelids closed, but the eyes brilliant and glassy, although without expression. Cold affusion, emetics, and stimulants restored her, and in twenty minutes her consciousness returned.(*r*) The general symptoms of poisoning with the oil of bitter almonds

(*r*) Lancet, June 8, 1844.

resemble very closely those by pure prussic acid, the principal difference being that in the former they are perhaps less instantaneous or immediate in their accession, and that the duration of life is somewhat longer. Nevertheless, cases of very rapid death from this oil are recorded.

Dr. Taylor mentions the particulars of a case referred to him, in which it was probable that the whole duration of the case did not exceed *seven* minutes, and the man was not seized by the peculiar symptoms of poisoning until *five* minutes after he had taken the dose. During this time he was conscious and self-possessed, and replied rationally to questions put to him.

In a case related by Mertzdorff, in which two drachms of the ethereal oil of bitter almonds were swallowed, death occurred in half an hour. Another one, related by Dr. Taylor, is remarkable not only for its termination in a similar short space of time, but from the fact of the smallness of the dose, which was only *seventeen drops*. A druggist swallowed half an ounce of "almond flavor," equivalent, it is said, to thirty drops of the oil. He fell insensible in less than half a minute. This case presents, moreover, this peculiarity, that there was a temporary remission of the symptoms. He was sensible for a few minutes, and spoke on the nature of his attack, but gradually again relapsed into a delirious and apparently very happy state. His eyes were extremely brilliant, but the pulse was quick and intermittent, and the whole body cold. He gradually recovered from the effects of the poison.(*s*) This case is a very extraordinary one; the peculiar effects cannot well be attributed to the smallness of the dose, since, as we have already seen, little more than half the quantity has proved fatal, and in this case it was strong enough to produce almost immediate insensibility. Mr. Iliff has reported a case in which death must have been very rapid. It is that of a young woman who poisoned herself in the Zoological Gardens, London. A small phial containing a drop or two of the oil of almonds was found in the pocket of her dress, with the cork pushed in.(*t*) In addition to the similarity in symptoms, the

(*s*) Lancet, Sept. 1839, p 930, Mr. Chavasse. (*t*) Lancet, April, 1850.

post-mortem appearances from this substance resemble those of prussic acid. The same placid and natural expression of countenance, and the same purplish color and fluid condition of the blood, are here found. But the odor is uniformly present, generally more or less about the mouth, but, in all the cases yet reported, very characteristic and penetrating in the stomach and cavities of the body generally. It is very persistent, and may be discovered several days after death.

The oil of bitter almonds is about four times as strong as the medicinal hydrocyanic acid of the United States Pharmacopœia. It is of a yellow color, has a bitter, acrid, burning taste, and is slightly soluble in water. The almond flavors and essences so much used in cooking are solutions of the oil in spirit, and may prove highly dangerous in the hands of ignorant people. Enough prussic acid is contained in less than an ounce of most of these flavors to produce fatal effects, and it is evident that smaller quantities might have the same result in the case of children.

There is a case related by De Keyser, which appears to show that the application of this oil to the skin may be dangerous. A lady used about half an ounce of it in mistake for an oil intended to make the hair grow. That the vapors of the oil did not occasion the symptoms is probable, because the waiting maid, who assisted her, was unaffected. She was seized with a coldness extending from the head and spine to every part of the body, followed by ringing in the ears and unsteadiness, deafness, swimming of objects before the eyes, and impaired power of moving the limbs. She fell insensible, and in a state of collapse resembling syncope. She gradually regained her consciousness, but the sense of coldness continued for several hours.(*u*)

§ 581. 9th. *Apricot kernels.*—At Arles, a child ate two or three apricots; but, not content with this, also took the kernels inclosed in the fruit. Very soon after he was seized with convulsions, and died in spite of every attention.(*v*)

§ 582. 10th. *Peach kernels.*—Dr. Keating, of Philadelphia,

(*u*) Journ. f. Phamakodyn., 1857, p. 588.
(*v*) Quoted in the Am. Journ. Med. Sci., Jan. 1853.

has reported a very interesting case, in which he succeeded, by affusion of cold water, in restoring a child three years of age, who had eaten a quantity of peach kernels. The child was seized suddenly, and when seen was found insensible, with slow, deep, sobbing respiration, no convulsion of the limbs, but slight twitching of the mouth, icy-cold extremities, finger-nails livid, hands slightly clenched, eyes prominent, and pupils dilated. A strong odor of prussic acid was perceived about the mouth. An emetic brought up a quantity of peach kernels, emitting the characteristic fragrance.(*w*) Another case is reported, in which the kernels of the cherry proved fatal to a child of five years, after forty hours' illness.(*x*)

§ 583. 11th. *Cherry-laurel water.*—The following case of poisoning by this liquid is remarkable for the slowness with which the symptoms supervened, and the unusually long duration of life. A hypochondriac of advanced age drank one morning an ounce and a half of cherrry-laurel water. The symptoms of poisoning did not come on for *three* hours. Then the hands and feet became paralyzed, and the head fell forward upon the chest. Involuntary discharges from the rectum and bladder took place. The extremities, though cold and immovable, were not insensible. The pulse was small, the voice hoarse but distinct, and the intellect perfect. The patient observed with pleasure the incessant progress of the weakness; he died in the evening, without pain or convulsions. On dissection, the blood was found gluey, and of a peculiar dark color; but no odor of bitter almonds was detected. The celebrated trial of Capt. Donellan, in 1781, on a charge of poisoning Sir Theodosius Boughton with this liquid, is no doubt familiar to the reader.(*y*) Cherry-laurel water is of uncertain strength, since the leaves gathered in the spring contain more prussic acid than when collected and distilled in the middle of the summer. It also becomes weaker by being kept. The medical dose is from forty minims to a fluidrachm.

§ 584. 12th. *Cyanide of potassium.*—This substance, as also

(*w*) Trans. of Phil. Coll. of Physicians, vol. iii. No. 3.
(*x*) Philad. Med. Exam., July, 1845.
(*y*) *Vide* Beck's Medical Jurisprudence, vol. ii.

probably all the salts of hydrocyanic acid, is equally destructive and rapid in its effects with the free hydrocyanic acid. The symptoms are exactly similar to those produced by the latter poison, as are also the post-mortem appearances. Dr. Finnell, however, reports having met with intense redness of the gastric mucous membrane in three cases of fatal poisoning by this salt.(*z*) But Dr. Schauenstein found a dark red color of the membrane with bloody points, in only two out of five cases,(*a*) and attributes this peculiarity to the caustic operation of the alkaline solution in a concentrated state, and when the stomach contains but little food. The odor of prussic acid is less striking, and less frequently perceived in poisoning with this salt. In a case of sudden death from it reported by Casper, there was no unusual odor, although the nature of the poison was detected by chemical analysis.(*b*) The reaction of the contents of the stomach is always alkaline, and according to Schauenstein, prussic acid can always be detected in them by the addition of formic acid. The writer states it as probable that the former is in every case converted into the latter. The quantity capable of proving fatal may be stated at from two and a half to five grains, since the former quantity is equal to one grain of anhydrous prussic acid. The fatal dose must necessarily vary with the strength of the preparation, and this is very different for different specimens. The strongest is made by saturating a solution of potassa with prussic acid. A man aged thirty died in a quarter of an hour after taking fifteen grains, prescribed for him by his medical attendant, in mistake for the ferrocyanide.(*c*) Dr. Perry related the following case to the Boston Society for Medical Improvement. A nurse administered this poison by mistake, to a child who had a slight cough, instead of a cough mixture, which stood near the bottle of solution of the cyanide. The immediate effects of the dose were vomiting and convulsions; then insensibility, locked jaw, coldness of extremities, which were

(*z*) Am. Med. Times, i. 33.
(*a*) Prager Vierteljahr., lxv. anal. 14.
(*b*) Vierteljahrschrift, July, 1854.
(*c*) Henke's Zeitsch., Bd. 45, H. 1, p. 6.

pendulous and without muscular power; diminished frequency of respiration (twelve to sixteen per minute), the pulse small but distinct, sixty per minute; the circulation languid, pupils dilated, sphincters paralyzed; the teeth closed so firmly and continuously, that only once or twice could anything be poured into the mouth. Dr. P. saw the child in fifteen minutes after the accident, and found it in a warm bath and insensible. It was treated by stimulants and the inhalation of ammonia. Death was sudden, and no *post-mortem* examination was made. The child lived *one hour and a half.*

A case is reported by Dr. C. E. Ware, of a woman who died in less than an hour from taking seven grains of this salt in a teaspoonful of liquid. Death occurred by gradual syncope.(*d*) In Vienna, Dr. Schauenstein met with five cases of fatal poisoning by this substance, in the course of eighteen months. In all of them the death seems to have been sudden. In one case, in a young girl, strong tetanic spasms came on directly after the poison had been taken.(*e*) The same symptom, with severe abdominal pains, occurred in a case reported by Prof. Wagner, of Leipzig.(*f*) The root and the juice of *Cassava* (Jatropha Manihot) produce symptoms identical with those of prussic acid, but, in general, they are less intense. De Keyser relates that three children who had eaten of the former, and an adult negro who had drunk about six ounces of the latter, recovered.(*g*)

Partridges.—There have been a few cases reported of poisoning from eating these birds in winter, and it has been supposed that the symptoms resulting therefrom have been due to prussic acid evolved from certain berries or laurel buds which these birds have eaten when deprived of their ordinary food, that the snow had covered. These cases(*h*) were not fatal, and, as the cause and form of poisoning are doubtful, they deserve but little notice here.

(*d*) Boston Med. and Surg. Journ., Dec. 1856, p. 387.
(*e*) Br. and For. Med.-Chir. Rev., Oct. 1859, p. 530.
(*f*) Archiv f. Phys. Heil., 1859, p. 417.
(*g*) Journ. f. Pharmakodyn., 1857, p. 586.
(*h*) Taylor, Medical Jurisprudence, p. 283; Boston Med. and Surg. Journ., July, 1871, p. 55.

III. *Chloroform.*

§ 585. 1st. *When injurious.*—Anæsthetic agents, now so much used in surgical, dental, and obstetrical practice, in the form of vapor, are, as is well known, capable of producing fatal effects. Occasionally death has been due to their maladministration, the patient being either unfitted to respire them, or having been required to inhale them unmixed with atmospheric air, or for too long a time. Such accidents have been extremely few in the case of ether, and, since the proper mode of its administration has been understood, that is, since care has been taken to admit a sufficient proportion of atmospheric air along with the ether into the patient's lungs, there is not a single authenticated example of its having destroyed life. Chloroform, being more energetic and rapid in its action, has so frequently been the evident cause of death, that the operator cannot be too careful to ascertain its purity, and the probability of his patient being able to bear it, and to see that he does not inhale it to the exclusion of the atmospheric air, or for too long a time.

§ 586. 2d. *Symptoms.*—Notwithstanding every precaution, however, occasionally death will suddenly occur in the most unexpected manner from its inhalation. This has occurred in the practice and under the supervision of the most eminent surgeons. Many cases have been published, which it would, however, be tedious to enumerate.(*i*) We append, however, one or two by way of illustration. Patrick Coyle, chloroformed for fistula; he inhaled for about a minute and almost instantly expired.(*j*) Abbey Pennock inhaled about three drachms in two applications, to relieve the pain of toothache, and died almost immediately after the second application.(*k*) John Griffiths had chancres and hæmorrhoids; inhaled about three drachms, and died in about ten minutes, during the incision of the hæmorrhoids.(*l*)

(*i*) Dr. Crisp laid before the Medical Society of London, a table which he had made, of the recorded deaths from chloroform, up to June, 1858. They amounted to *forty-two*. At the end of 1859, they had already exceeded sixty in number.

(*j*) Dr. Warren, Effects of Chloroform, etc., Boston, 1849.

(*k*) Ibid. (*l*) Ibid.

In the case of Madame Labrunne, related by M. de Confevron, the fatal effects were manifested in eight seconds, and the operator remarked constant winking of the eyelids. The patient repulsed the dentist's hand, making signs that the effect was not complete. She then made four or five fuller inspirations. At that instant, M. de Confevron removed the handkerchief, and only took his eyes off her for the instant occupied by placing it on the table; but in this brief instant, he found the patient's face turned pale, the lips discolored, the features altered, the eyes turned upwards, the pupils horribly dilated, the jaw closed, the head drawn backwards; the pulse could not be felt, the limbs were all relaxed and a few inspirations at long intervals were the only indications of life.(*m*)

Up to the beginning of the year 1867, the total number of recorded deaths by chloroform inhalation were one hundred and thirty-three, in thirty-three (twenty-five per cent.) of which no possible explanation of death, in the state of our present knowledge, could be given, other than that of poison.(*n*) Since that time the number recorded in the various medical journals of death which could be imputed only to the use of chloroform inhalation is very considerable.(*o*)

Such cases as these can leave no doubt upon the mind that death was attributable solely to the inhalation of chloroform, and that it may occur with a celerity unparalleled by any other poisonous agent whatever. In cases of ordinary surgical practice, when the chloroform is administered by a competent person, and with those precautions which experience has shown to be necessary, the surgeon is probably not culpable in the eye

(*m*) Med. Gaz., vol. ix., 1849, p. 395; *vide* also Med. Times and Gaz., Oct. 1852, p. 361; April, 1853, p. 369; Aug. 1853, p. 173; Oct. 1853, pp. 407, 422, 461; Nov. 1853, p. 562; Dec. 24, 1853, p. 665; Lancet, June and Oct. pp. 523, and 410; Edinb. Monthly Journ., April, 1850, p. 377; 1855–6, i. p. 524; Med. Gaz., vol. ix. 1849, p. 295.

(*n*) Am. Journ. of Med. Sci., Oct. 1867, p. 324.

(*o*) *Vide* also Medical News and Library, Philad., vol. xxvii. pp. 89, 103, 118; Medical Times and Gazette, London, June, 1869, p. 695; Nov. 1869, p. 579; New York Medical Journal, vol. x. p. 194.

"The rate of mortality is as 1 in 3500 administrations of chloroform (I really think it is as 1 in 2000 to 3500); we have no other remedial agent which approaches chloroform in point of danger." (B. W. Richardson, M.D., F.R.S., London Med. Times and Gaz., 1870.)

of the law; but increasing familiarity with its soothing effects, and ignorance of its toxical properties, may be the source of fatal results in the hands of unqualified persons. A case bearing upon this point has been reported.(*p*) Here the chloroform was procured and administered by a nurse, to a woman in labor, contrary to the injunction and without the knowledge of the physician. The woman's death could be attributed to no other cause than the inhalation of chloroform.

§ 587. The external phenomena of etherization, whether produced by chloroform or ether, are very nearly alike. There is usually at first a little cough, with expectoration of mucus and a flow of saliva, and some laboring of the respiration; then the inspirations become strong and deep and take place without difficulty; the pulse becomes quickened, and the eyes injected. With these early symptoms, there are often irregular movements of the limbs, and expressions of various kinds are uttered; sometimes a patient will try to put away the sponge or instrument used, but more generally he is anxious to retain it. If the inhalation goes on, the face generally becomes flushed, the eyes are brilliant, and turn in different directions, often upwards; soon the eyelids droop; very often now there are laughter and incoherent expressions; the pulse begins to be slower, and a general insensibility with muscular relaxation follows. This is the true surgical period of anæsthesia. If this period be surpassed and etherization be pushed to its utmost limits, the respiration becomes stertorous, the face livid, the pulse slow and weak, and death may take place. To sum up, temporary excitement, then stupefaction or disorder of the intellectual powers, insensibility, and death, are the three great and observable stages of etherization pushed to its utmost limits.(*q*) We have already described the psychical effects of the inhalation of the vapors of ether and chloroform. (*Vide* RAPE.)

Serious and alarming symptoms of chloroform may arise from taking it *internally*. A lady, weakened by miscarriage, was affected, within five minutes after taking half an ounce of

(*p*) Med. Times and Gaz., April, 1855.
(*q*) Brit. and For. Med.-Chir. Rev., Jan. 1852.

chloroform, with convulsions, insensibility, dilated pupils, *trismus*, flushed face, a full and oppressed pulse, and foaming at the mouth.(*r*) Another person, also a female, took two ounces of chloroform; there was a deep stupor without congestion of the face, and the pupils were contracted.(*s*) In neither case was the pulse reduced. In a third case the symptoms were the same as in the second, and were also produced by two ounces of the liquid.(*t*) When death has been produced by the internal use of chloroform, its local irritant action has evidently been the chief cause of the fatal result. Three cases, at least, of this description are recorded.(*u*) In all of them the quantity taken was from one to two ounces, and the local symptoms were those of an active irritant of the stomach. In one case the air-passages shared in the irritation, and their congestion was the immediate cause of death. In all, examination of the bodies showed softening of the mucous membrane of the stomach, and in one case ulceration also.

§ 588. Poisoning by the internal administration of chloroform is totally distinct from the effects produced by its inhalation.(*v*) The quantity of chloroform necessary to occasion serious symptoms is variable. One drachm of the liquid chloroform has brought on narcosis, and this followed by death in the case of a boy four years old.(*w*) In another case of a private(*x*) in a cavalry regiment, two ounces were swallowed, which caused serious narcotic symptoms. The stomach was washed out by means of a stomach-pump, twenty minutes after the taking of the drug, and then ammonia was injected. This man recovered.

The effects of chloroform, taken internally, appear in from ten to twenty minutes, and are very similar to alcoholic intoxication; but these only precede the more serious symp-

(*r*) Med. Times and Gazette, Dec. 1857, p. 615.
(*s*) Annuaire de Thérap. xviii. 55.
(*t*) Am. Journ. of Med. Sci., Oct. 1857, p. 367.
(*u*) Month. Journ. of Med. Sci., v. 77; Philada. Med. Exam., Nov. 1856, p. 659; London Lancet, April, 1859, p. 400.
(*v*) Tourdes, Gaz. Hebd. de Médecine et Chirurg., Paris, 1866.
(*w*) Taylor on Poisons, p. 741.
(*x*) Amer. Journ. of Med. Sciences.

toms of coma, complete insensibility, stertorous respiration, and convulsions; and finally death in a few hours. Most generally, however, the patient slowly recovers his consciousness, but is left with a pain in the throat and stomach, and often has jaundice, cough, and a slight catarrhal bronchitis. These symptoms are those related by Tardieu and Taylor, each of whom give illustrative cases.

The only peculiar post-mortem irregularities to be recorded are the slow putrefaction and persistent rigor mortis, and a special odor of chloroform; but as this latter is much more volatile than ether, and less pungent, it is not so readily recognized. Consequently all the organs and tissues reserved for chemical examination should be kept as much as possible from the air.

§ 589. In regard to the mode in which the inhalation of chloroform occasions death, a review of the fatal cases furnishes a very uniform result, and in general shows but very few symptoms as precursors or concomitants of death. In a very small number more or less twitching of the muscles of the face and extremities, and in two or three instances spasmodic contractions of the muscles of the lower portion of the body, have been noticed; but, in general, the breathing grows feeble and infrequent, the pulse small and faint, and the face pale and cold. In a smaller proportion of cases the features are congested instead of pallid, and in these the respiration is more or less stertorous, and there is sometimes foam upon the lips. In the former group the mode of death indicates exclusively a direct poisonous action of the chloroform, producing an arrest of the heart's action, or syncope, while in the latter are *superadded* the effects of an exclusion of atmospheric air, in other words, the signs of asphyxia.

Casper treats of a *chronic poisoning by chloroform*,(*y*) maintaining that the vapor may prove fatal after the lapse of hours, days, or even weeks, the patient meanwhile suffering more or less from its effects.

§ 590. 3d. The *post-mortem appearances* found in those who have perished by chloroform are remarkably uniform; they are,

(*y*) Gericht. Med., i. 621.

great congestion of the lungs and bronchial tubes, whilst the blood may be dark and fluid. Exceptions have, indeed, been observed to this rule, but in a very large majority these appearances are constant. This condition is not, however, significant of any peculiar action of chloroform upon the blood. As Dr. Snow has remarked, it generally remains fluid after death by chloroform, only because it remains fluid in every kind of sudden death.(*z*) It is found equally so in death from any asphyxiating cause, and in cases of narcotic poisoning. It may also be due to disease. Dr. Faure is of opinion that the congestion of the lungs met with in death from chloroform is, to some extent at least, an hepatization produced by the combination of the vapor with the blood in the vessels.(*a*)

§ 591. *Detection of chloroform.*—This is a very easy matter if not delayed long after death, but unless the chemical research is undertaken very soon the volative agent will not be detected.

§ 592. The method to be employed (*b*) is that proposed by Duroy, and consists in forcing over from a retort, warmed slightly (about 107° F.), and containing blood liver and brain tissue finely divided, the vapor of chloroform through a hard-glass or porcelain tube heated red hot into a potash-bulb containing a solution of nitrate of silver slightly acidulated with nitric acid; if chloroform be present a flocculent white precipitate of chloride of silver will be seen in the silver solution. The addition of a few drops of nitric acid to the latter is necessary, or otherwise certain organic substances passing over with the vapor may be decomposed into cyanogen, and this will obscure the solution, and cause a liability to error. The vapor may be forced out of the retort by a pair of bellows attached to a tube resting just above the organic matter, or else by an aspirator placed at an outlet of the potash-bulb. Care should be taken to force the vapor through the combustion-tube quite slowly. By this process the chloroform is decomposed into chlorine and hydrochloric acid, which forms with the silver chloride of silver. This latter may be recog-

(*z*) On Anæsthetics, p. 248. (*a*) Arch. Gen., Jan. 1860, p. 56.

(*b*) Du Rôle de l'Alcool et des Anesthetiques dans l'Organisme, Lallemand, Perrin, et Duroy, Paris, 1860.

nized in the following ways: it is insoluble in water and boiling nitric acid,(c) but is easily soluble in a slight excess of ammonia; and if the solution containing the precipitate be boiled, black oxide of silver will be reduced. Provided no white flocculent precipitate has been produced in the silver solution by the above process in fifteen minutes after the combustion has been heated to redness, the experimenter may fairly conclude that no chloroform is present.(d)

Fallacy.—Any free hydrochloric acid in the tissue must be examined first of all by litmus paper, and if it is present a little soda or potash should be added. If chloral had been taken by the patient just previous to death, and the soda and potash be added to the tissues, the chloral would become decomposed into chloroform.

§ 593. Chloroform when present in organic mixtures can also be obtained by distillation.

The reader will find in the note some important considerations relative to the mode of death by chloroform, and the means of obviating the frequent accidents which attend its employment.(e)

(c) Cyanide of silver is soluble in the latter, and can thus be distinguished from the chloride.

(d) *Vide* some experiments concerning chloral; by the editor of third ed., in the New York Med. Journ. for June, 1872. Also, Sansom on Chloroform, 1866. Lindsay & Blakiston, p. 45.

(e) *Report on an Experimental Inquiry Concerning Accidents by the inhalation of Chloroform.*—The *Société d'Emulation* of Paris appointed a committee for the above purpose, which met forty times to conduct a series of one hundred and fifty experiments upon different classes of animals. The results of their labors are detailed by M. L. Lallemand in the present report; but we must confine ourselves to recording his conclusions.

1. The action of chloroform upon the economy takes place with a rapidity directly proportionate to the amount of concentration of the inhaled vapor—the phenomena being, however, always manifested in the same order, and with the same characteristics. 2. The excito-motor properties of the nervous centres, the sensibility and motricity of the cerebro-spinal nerves are suspended by chloroform; but the excitability of the medulla, and the motricity of the nerves continue to be manifested under the electric current. 3. Chloroform possesses an especial elective affinity for the nervous centres, in the substance of which it becomes accumulated during inhalation, and is there found after death in a much larger proportion than in other organs. 4. The respiratory movements cease before the action of the heart. 5. After

§ 594. *Medico-legal bearings.*—Dr. Charles Kidd, in *Edinburgh Medical Journal*, September, 1870, says, that the following five points are deducible from an increasing experience with chloroform: 1st. Dilatation, or rather engorgement of the

the respiratory movements are suspended, the animal, if left to itself, dies. 6. Chloroform is rapidly eliminated from the economy, the pulmonary surface being the principal agent in elimination. 7. In the majority of cases, the suspended vital functions can be re-established by means of the insufflation of air, or oxygen gas, even after all apparent circulatory movements are abolished. 8. In order to succeed, it must be resorted to immediately after the suspension occurs, and be steadily persevered in until the normal actions are completely re-established. 9. Artificial respiration, produced by the faradization of the phrenic nerves, may likewise re-establish the suspended vital functions. 10. Electricity, employed as a general stimulus of the nervous system, is powerless, and it rapidly exhausts the nervous excitability of animals in the last stage of chloroform intoxication. 11. Insufflation acts by stimulating the excitability of the nervous system, and inducing elimination of the chloroform by the pulmonary surface. 12. Death ensuing on the inhalation of chloroform takes place from the abolition of the action of the nervous system, and not from asphyxia or paralysis of the motions of the heart. 13. The dilution of the vapor of chloroform with a considerable and constant proportion of air, will, if not entirely prevent, very much retard, the danger of intoxication.

Applying these results to the human subject, the reporter feels convinced that insufflation of air, effected by means of a tube passed through the mouth into the trachea, and connected with a bellows, if commenced at once on the development of accidents, and continued with perseverance, will, in the majority of cases, prove perfectly successful. Local faradization of the phrenic nerves is only of secondary importance, compared with insufflation. By the latter, as much air as is desired can be introduced, the energies of the circulation becoming aroused and elimination of the poison favored; while, under the employment of electricity, the excitability of the nervous system is apt to become exhausted.

In a *preventive* point of view, it is to be observed, that in all the experiments the respiratory movements first ceased; so that such suspension becomes the signal of the intense poisonous influence exerted on the economy, and the imminence of death. These movements, therefore, require especially to be watched during the administration. The chloroform, too, should be employed only when diluted with air, and care be taken not to administer large additional doses when the effect is commencing to take place. Owing to their density, the atmosphere near the patient remains charged with the vapors, which may easily thus become inspired in greater concentration than is supposed.

The reporter furnishes a drawing of a new apparatus, contrived by M. Duroy, for the purpose of administering a diluted chloroform, which he terms an *Anæsthesimeter.*—*Med. Times and Gaz.*, March 10, 1855, from *L'Union Médicale*, No. 13, 1855.

right side of the heart may be calculated on, if the post-mortem be made correctly, and the patient may not have died of simple syncope rather than this apnœa. 2d. Chloroform may be recovered by distillation from blood and lung tissues. In this, it differs perhaps from nitrous oxide. 3d. Chloroform acts slightly upon the blood corpuscles, they being jagged or crenated at the edges, while ether breaks them up; the lungs, however, are usually anæmic or pale under chloroform. 4th. Chloroform is more fatal in the struggling stage, or if there be signs of delirium tremens present. 5th. Great caution should be observed in believing the confused ideas of women menstruating at the time of taking chloroform.

§ 595. Dr. Stephen Rogers, president of the Medico-legal Society of New York, has contributed to the *Journal of Psychological Medicine* for October, 1871, a very interesting essay on the question "whether chloroform can be used to facilitate robbery." He maintains the negative in an argument from which we extract the following:—

"Referring to the case of the jeweller's shopman, who alleges that the wife covered his face with a handkerchief, while the husband held his hands; it must be obvious to any one at all acquainted with the use of chloroform, that the theory of his allegation is preposterous. Would a strong man, determined to save himself from impending suffocation, stand passively and allow a man and a woman to practise the administration of chloroform on him? He could at least have fallen down and turned his head away enough to have enabled him to scream for help, like the man Kendal, or the young woman in the stable-yard. From all the light which practical experience and the investigation of crimes throw upon this case, there seems little doubt that the shopman was party to the robbery.

"It is at least a very suggestive case, as showing that there is great liability to err on the part of courts in accepting this kind of allegation, unless, upon detailed inquiry into the circumstances and the manner of the alleged giving of chloroform, they be found consistent with the thoroughly well-known facts and phenomena uniformly attending the administration and action of this agent.

"Any inconsistency such an inquiry might develop should be accepted as indicating honest delusion, studied deception, or complicity in the crime.

"I feel convinced that such a test would exclude, at least, nineteen in twenty of all these cases of the alleged felonious use of chloroform and similar agents, as mere fictions.

"But as there may be, as in times past there has been, a popular disposition to accept the statements made by the alleged victims of the felonious use of chloroform, and by their friends, as true, notwithstanding what I may say, or other authors may say to the contrary, with the single motive of bringing before the public and the legal profession all that may be true and well authenticated in this matter, I have challenged, and I now repeat it, the production of any proof of the successful use of chloroform on the human subject to facilitate robbery in a single instance.

"As I have before had occasion to say, when any such proof is furnished me, that robbery has ever been committed by means of the use of chloroform received unconsciously by the person robbed, or given forcibly against the resistance of the person robbed, I will be ready to admit it, and this Society will promulgate the fact to the world.

"And I cannot conclude these remarks in a more truthful and forcible manner than by adopting the language of Dr. Snow, who so long ago said: 'The public have been greatly and unnecessarily alarmed about the employment of chloroform by thieves; what they really have to dread is, that robbers will still resort to the old means of the bludgeon, the pistol, and the knife, and not to one, which, like chloroform, allows the victim so good an opportunity of escape, and themselves so great a chance of detection.'"

Dr. Snow says: "The sensation of pungency in the nostrils and throat that is caused by this agent when its vapor is in sufficient quantity to produce any effect on the sensorium, is so strong and peculiar, that no person can take a single respiration without being aware that he is inhaling something very unusual. Chloroform, in fact, can never be administered without the consent of the party taking it, unless by main force, which has to be used in the case of children who are

not old enough to be reasoned into taking it. If a child be asleep when the process of inhalation is commenced, it nearly always awakes before being made insensible, however gently the vapor may be insinuated. As breathing is perfectly under the control of the will, a person would, on finding such a strange attempt being made upon him in the public street, instantly hold his breath, and use all his powers of resistance to repel the assault," etc.(*f*) Lord Campbell, in his speech in the House of Lords advocating the adoption of the bill making unlawful administration or application of chloroform and other stupefying agents felonious, made the following remarks: "A most respectable physician had done him (Lord Campbell) the honor to write him a letter, which he had printed, and there he stated the fear arising from the use of chloroform in this way was altogether imaginary, that no strong man who made resistance could possibly be chloroformed. He believed that was true; but in the case of those who were not strong, and unable to resist, it might happen to many of that class, that the chloroform would be employed most effectively for facilitating robbery. The gentleman to whose letter he had referred, stated that a person thus attacked might refuse to breathe, and that he might turn away his head. But, suppose a wet handkerchief was put to his nostrils, and held there, the man must breathe and thus inhale the particular gas that came from the chloroform. It stood, indeed, on record, that since the discovery of chloroform, persons had been convicted before the competent courts of using that article for the purpose of robbery. He hoped, therefore, their lordships would be of opinion that those who made such an attempt should not be guilty of a misdemeanor only, as was at present the case; but that any person who tried to commit a robbery by means of chloroform or such like substances, *though he did not succeed*, should, if convicted, be held guilty of felony, and be liable to be transported beyond the seas."

We have not seen the evidence brought forward in the cases thus referred to, but we do not doubt that it was fully sufficient to establish the fact of chloroform having been used for

(*f*) Lond. Med. Gaz., 1850.

the purpose alleged; the only recorded instance which we have met with is the following; its employment was, however, as will be seen, unsuccessful. A gentleman named Mackintosh had retired to bed at a hotel in Kendal. He was awaked about twelve by a man attempting to suffocate him by means of a rag steeped in chloroform. Mr. Mackintosh, who is an elderly man, struggled desperately with his assailant; but, whether from the fumes of the chloroform, or the disadvantage at which he was taken by his midnight assailant, he felt himself fast fainting, when his cries of "Help! murder!" roused the house. When the landlord made his way into the room, Mr. Mackintosh was almost powerless, and his assassin or robber was lying upon the bedding, which had fallen upon the floor in the scuffle, apparently sound asleep. On being roughly shaken, the latter professed that he had long been a sleep-walker, and appeared to be astonished to find himself where he was. A policeman was sent for and the man taken into custody. A strong smell of chloroform was perceived by the parties who entered the room upon the alarm being given, and a bottle containing chloroform was found under Mr. Mackintosh's bed, and a similar bottle in the carpet-bag of the prisoner, who had been at the hotel several days. The probability was that the ruffian was secreted under the bed when Mr. M. retired to sleep, as the latter had placed a chair previously against the door to prevent intrusion, there being no lock upon the door.(*g*) This criminal escaped with eighteen months' imprisonment; the offence not being a felony at that time, since there was no intent to commit *murder* shown.(*g*[1])

(*g*) Med. Gaz., Nov. 1850.

(*g*[1]) The following testimony is taken from the records of a recent trial (New Bloomfield, Perry county, Pa., Jan. 18, 1871,) for an attempt at robbery by the use of chloroform:—

Dr. F. F. Maury, M.D., recalled: Chloroform *very, very* often produces resistance. It sometimes produces irritation and sometimes a depressing feeling. It produces vomiting. If the stomach is full, nausea and vomiting almost always follow. Sometimes it does not. I experimented with chloroform in six sleeping persons. Out of that number all resisted, more or less. Two *men* woke up immediately, and one remarked, "You are trying to give me something." Unquestionably, it requires more chloroform to produce

Several remarkable instances of robbery of persons designedly rendered insensible by chloroform have lately been re-

death in a recumbent position than in an upright posture. One man cannot administer chloroform on another.

Chloroform will not mix with water; will mix with alcohol. Thrown into water, it breaks into small pieces, as it were. I administered it to a child *four days* old. It offered resistance. With my experience I could not administer chloroform to *four persons*.

B. Howard Rand, M.D., sworn: Am Professor of Chemistry and Lecturer on Medical Jurisprudence in Jefferson Medical College. Cases are numerous where persons have been overcome by smoke and noxious gases, and have perished without attempting to escape. They have been found near lime-kilns, brick-kilns, cement-kilns, and in houses on fire. The gases formed when wood or coal is burned are chiefly carbonic oxide and carbonic acid. They are both capable of causing death by suffocation. Carbonic oxide is by far the more poisonous; a single inhalation of the pure gas will produce insensibility; it acts like chloroform to produce insensibility, but is vastly more powerful; death is the rule and recovery the exception after the inhalation of carbonic oxide, while the reverse is the case with chloroform. When a house is burning, insensibility may result in part from the diminution of the oxygen within it. When the proportion of oxygen falls below about 18 per cent. insensibility will follow. The vapor of chloroform is 4.2 times heavier than an equal bulk of air. Gases and vapors diffuse or mingle more slowly as they are heavier. Chloroform vapor formed from the liquid poured on the floor would form a layer near the floor, from the upper surface of which, supposing the air of the room to be quiet, diffusion would slowly take place, so that the smell of chloroform would be perceptible in the room, but not enough of the vapor would arise to stupefy; the greater part of it would make its way under the door and through cracks, if any existed, in the floor. This vapor is so heavy that it can be poured like a liquid from one vessel into another. It is not inflammable, and puts out a light. The experiment detailed by Dr. Maury was made at my suggestion, and as a participant I confirm his statements. We concluded the experiment at the end of fifty minutes because we were satisfied that no different result would be arrived at by prolonging it. The only effects noticed were quickening of the pulse of those in the close room, with a pound of chloroform on the floor, except that I was nauseated by the smell of the chloroform vapor, but did not vomit. Mr. Boman remained the whole time lying on the floor with his head resting on his hand, at an average distance of seventeen inches from the floor, and was unaffected, except as before stated.

Cross-examined.—Chloroform vapor, as ordinarily administered, when it kills, does so not by deprivation of oxygen, but from its own noxious qualities. In lime-kilns a large amount of the noxious gases arise from the decomposition of the limestone, which consists of lime combined with carbonic acid; in the case of brick and cement-kilns, the noxious gases arise from the fuel. The proportion of carbonic oxide to carbonic acid in any case will vary; in a smouldering combustion, one where the supply of air is limited,

ported in the newspapers of this country; although they may be authentic, we do not feel warranted in further alluding to them while unable to attribute them to responsible sources. It is obvious that a person may allege that he has been robbed or maltreated after being rendered insensible by chloroform, but also that the allegation may be false, and be put forward so as to divert suspicion or awaken sympathy.

CHAPTER IX.

NARCOTIC POISONS—(CONTINUED.)

Alcohol, § 596.
Symptoms, § 598.
Producing sudden death, § 599.
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Camphor, § 601.
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Lactuca (Lactucarium), § 605.
Solanum (Bittersweet), § 606.
Datura stramonium (Jamestown weed).
Nature and effects, § 607.
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Nicotiana tabacum (Tobacco), § 609.
Post-mortem appearances, § 611.
Nicotina, § 612.
Chemical character, § 613.
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Any liquid or volatile alkaloid, § 615.
Conium maculatum (Hemlock).
Its action, § 616.
Symptoms, § 617.
Conia or conicine, § 618.
Effects, § 619.
Detection in organic mixtures, § 620.

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carbonic oxide would predominate; where the supply of air is abundant, carbonic acid would be formed in larger quantity. Anthracite would weight for weight yield more carbonic oxide than charcoal, and charcoal than wood. Ordinary smoke contains, beside the noxious gases mentioned, many other bodies, as steam, tar, wood spirit, wood vinegar, etc., the nature and proportions of which will vary with the dryness of the wood and the temperature or degree of heat to which it has been subjected.

IV. *Alcohol.*

§ 596. 1st. The pernicious effects upon the system, of the abuse of alcoholic liquors, are too well known to need any mention here. We propose, therefore, to refer only to their immediate poisonous action when taken in large quantity into the stomach.

Death, from this rapid saturation of the system with alcohol, is by no means rare. Orfila mentions an instance in which a man died immediately from the effects of a large dose of brandy.(*h*) Dr. Rösch relates three cases in which adults died from the immediate effects of excessive drinking in a few hours.(*i*) Taylor says that a man died in half an hour after swallowing a bottle of gin for a wager. Rösch also relates the cases of two children in which quite a small quantity proved fatal. The one was a boy aged two years, who drank some brandy and soon after became comatose, had convulsions, and died in a few hours. The other was a little girl of four years, to whom her uncle had given about two tablespoonfuls of spirits. The child soon sank down insensible, was seized with convulsions, and, in spite of all remedies that were used, died within twenty-four hours. In another case, the same quantity of brandy was given to a child six months old, to keep it quiet during the night. In less than a minute it was attacked with convulsions; its face was purple, the eyes staring, the pupils dilated and insensible, the mouth open, the head extremely hot, while the rest of the body was cool, the breathing stertorous, and the pulse hardly perceptible. It had also bloody evacuations. It died, in a state of coma, in nine hours.(*j*)

§ 597. In general, the state of stupor is preceded by a short period of great excitement, but in some cases this preliminary stage is either very short or entirely absent. The difference probably depends upon the strength and quantity of the spirit and the age of the person.

§ 598. 2d. *Symptoms.*—The general characteristics of the comatose stage in the adult are the following: The face may

(*h*) Op. cit., ii. 528. (*i*) Henke's Zeitschrift, 1850, 4 H.
(*j*) Deutsch. Canstatt's Jahrsbericht für 1851, Bd. 10, p. 286.

be either pallid or flushed; the pupil at first contracted, and afterwards dilated and insensible to light; respiration slow and sometimes stertorous; the pulse quick and jerking, and the limbs cool and relaxed. In general, the appearance is very much the same as in poisoning by opium, or as in the apoplectic condition. In the absence of any knowledge of the mode of accession of the symptoms, the diagnosis of the case will often be incomplete. The odor of alcohol upon the breath is of course an uncertain sign, since ardent spirits may have been swallowed without being the cause of the symptoms. The ability to arouse the patient temporarily is also no means of distinction, as this may be possible in the stupor from intoxication.

In fact, should the individual die, the physician will often be left in doubt of the origin of the symptoms until some evident cause for them is found in the *post-mortem* examination. Even then nothing may be found to throw light upon the case, since a person presenting the above symptoms may have died of concussion of the brain, which leaves no ascertainable morbid change. If the symptoms have been due to opium or other narcotics, these may not be discovered, and, as will presently be seen, the evidences of death from alcohol may also be deceptive. It will only be from a careful analysis of the history of the case, and comparison of it with the post-mortem signs, that the physician can hope to come to a probable conclusion.

§ 599. Mention should be made here of the foolish and criminal bets, that have caused sudden and frightful deaths, from drinking a large quantity of some alcoholic beverage. This has been observed not only among those who have by long experience acquired a certain immunity from the frightful use of excessive doses of alcohol, but also among persons little used to alcoholic excesses; and who have allowed themselves to drink a quart of alcohol, hardly stopping a moment to take breath. These unfortunates fall, as if struck down, into a profound coma, accompanied by little convulsive muscular shocks. Respiration, at first stertorous, becomes more and more difficult; and a bloody froth appears on their lips. Involuntary evacuations occur, and they die sometimes in an

hour or half an hour, and sometimes as soon as fifteen minutes after the fatal drink.

At the autopsy clotted and thickened blood is found in the cavity of the arachnoid and also in the lung tissues. A case has been recorded at length, illustrating this form of alcohol poisoning.(*k*)

§ 600. The post-mortem appearances after death from alcohol are congestion of the brain and lungs; a strong odor of alcohol may also be perceived in the tissues of the body. The alcohol may be separated by distillation or detected by means of oxide of chromium, which is so delicate a test that it reveals the presence of a very slight trace.(*l*)

Chemical tests.—In cases of suspected poisoning, the liquid should be distilled by means of a water-bath, and the product rectified with fresh lime or carbonate of potassa. The alcohol, if present, may be drawn off by a few fibres of asbestos and burnt. If in sufficient quantity, it will be detected by its odor or solvent action on camphor. If in very small quantity the heated vapor should be conducted through a tube containing a few fibres of asbestos moistened with a mixture of bichromate of potassa and strong sulphuric acid. If only a trace of alcohol is present, green oxide of chromium will be precipitated on the asbestos. Ether and pyroxylic spirit produce a similar decomposition; but these liquids are detected by their peculiar odors.(*m*)

V. *Camphor.*

§ 601. 1st. *Symptoms.*—Although camphor cannot be regarded as a very active poison, no well-authenticated case of death resulting directly from its use having, as far as we are aware, been yet reported; it is, nevertheless, capable of producing very dangerous symptoms. These, in the cases which are known, have varied somewhat, but in all there has been more or less evidence of its action upon the brain; vertigo, confusion of intellect, delirium, and somnolence being the most prominent effects. Indeed, the primary action of large doses of camphor is a powerful but not a permanent sedation

(*k*) Tardieu, op. cit., p. 847. (*l*) Duroy, op. cit.
(*m*) Brande and Taylor.

of the nervous and vascular systems, followed by ataxic phenomena, and remotely by slight and very transient febrile excitement. Dr. Florain has reported the following curious case: A man 56 years of age and of good constitution, took for the relief of priapism, and under a misapprehension of the directions of his physician, an enema containing *ten* drachms of camphor. Immediately afterwards he had sensations of cold alternating with heat in the lower bowels, and these sensations extended along the spine to the neck, and spread over the whole body. He was then seized with vertigo, had grotesque hallucinations, an excessive frequency of the pulse, embarrassed respiration, vomiting, and strangury, and was greatly prostrated within two minutes after taking the injection. The delirium increased, the features became pale and decomposed, the eyes fixed, and the pupils dilated. The skin became covered with clammy perspiration, and was ice-cold, the pulse frequent and thready, and the impulse of the heart very feeble. When violently aroused the patient regained his consciousness for a moment, complained of distressing nausea, extreme chilliness, and great desire to sleep. Vomiting of a yellow watery fluid, smelling of camphor, followed, and was succeeded by great prostration. By the assiduous employment of stimulation, both externally and internally, as well as purgatives, the patient was rescued from this very precarious situation. He recovered entirely, and the only durable effect of the camphor was seen in the complete anaphrodisia which lasted for several weeks.(*n*) Two other cases are reported where the camphor was also given in injection (of about a drachm), and which were followed by analogous symptoms. In one of these the symptoms were very similar to those of an epileptic convulsion.(*o*) Dr. O. E. Brown, of Kentucky, mentions the case of a young man who chewed and swallowed about 100 grains of camphor. No symptoms came on for a short time, but he was, perhaps an hour afterwards, suddenly seized with convulsions, and remained unconscious for several hours. He was relieved by bleeding and a warm bath. He

(*n*) Gaz. des Hôpitaux, No. 41, 1851.

(*o*) Canstatt's Jahresbericht für 1851, Bd. iv. p. 277.

gradually recovered his speech, but remained stupid, languid, and wandering all the next day.(*p*) A few cases are quoted by Drs. Taylor and Christison, in which camphor was taken by the mouth, but they do not differ essentially from the preceding.

2d. *Power.*—The smallest dose which appears to have been attended with serious symptoms, is *twenty grains.*(*q*) In a case related by Wibmer, as much as eight scruples of camphor were swallowed by a drunkard, dissolved in spirit. It was followed by vertigo, dimness of sight, delirium, and burning pain in the stomach; there was no vomiting, and yet the man recovered. The nature of the poisonous agent cannot fail, in cases where camphor has been taken, to be discovered, since the odor is so powerful and so well known as to betray itself at once.

VI. *Hyoscyamus Niger.* (Henbane.)

§ 602. All parts of this plant are poisonous. The root is long, tapering, whitish, and fleshy, and bears considerable resemblance to parsley and parsnip roots, and has been eaten in mistake for them. Dr. Houlton states that, in a monastery where the roots had been eaten for supper by mistake, the monks who partook of them were seized in the night with the most extraordinary hallucinations, so that the place became like a lunatic asylum. One monk rang the bell for matins at twelve o'clock at night; of those of the fraternity who attended to the summons, some could not read, some read what was not in the book, and some saw the letters running about the page like so many ants.(*r*) Orfila relates two cases in which paralysis, delirium, and insensibility, together with tetanic symptoms, were caused in two soldiers who ate of the young shoots of this plant.(*s*) The seeds are still more active. Two young children, having eaten some of them, became actively delirious, and even maniacal, striking and biting all who came in their way. Their faces were red, hot, and swollen, and the pupils dilated. They were gradually restored by the use of emetics, local depletion, and sinapisms to the extremities.(*t*) Another

(*p*) Bost. Med. and Surg. Journ., vol. xxxvi. p. 368.
(*q*) *Vide* Taylor on Poisons.
(*r*) Lancet, July 6, 1844.
(*s*) Toxicol. gener., ii. 264.
(*t*) Henke's Zeitsch., 1848, 4 H. p. 516.

similar case is related in the same journal, but, the seeds being unripe, the symptoms were still more alarming.

§ 603. The medicinal preparations usually given are the tincture and extract. Both of these vary greatly in strength. The dose of the former is a fluidrachm, of the latter five grains, on an average. Dr. Cabot, of Boston, gave three teaspoonful doses of the tincture, at intervals of an hour. Ten minutes after the last dose, the face began to swell, and become red and polished, the eyes were closed, and the patient was able to speak only with the greatest difficulty, on account of the tongue and lips. The red discoloration of the skin extended as far as the navel, and was attended with intolerable itching and burning.(*u*) Delirium and hallucinations, after fourteen grains, in divided doses, were met with by Reinbold, of Hanover.(*v*)

The only two cases of death alleged to have been caused by hyoscyamus were reported, the one in 1715, by Walther,(*w*) and the other by Lindern, who is quoted at second hand by Orfila.(*x*) This result may therefore be regarded as extremely rare. A case of poisoning by the fruit of hyoscyamus is recorded in the *British and Foreign Med.-Chir. Review* (1859), with almost identical symptoms of the case of Dr. Cabot, related above.

Hyoscyamine in the dose of $\frac{1}{33}$ gr. has reduced the pulse from 79 to 18. In medicinal doses it occasions dryness of the mouth and throat, lowers the pulse, dilates the pupils, and induces sleep.

§ 604. VII. *Haschisch*, or *hatchy ratchy*, a narcotic much used by the Turks and Arabs in place of opium, for the purpose of producing intoxicating effect after their meals, is composed of a mixture of hyoscyamus, bitter almonds, and the juice of hemp-root (*cannabis indica*). A single teaspoonful of this preparation is said to be sufficient to deprive the strongest

(*u*) Am. Journ. Med. Sci., Oct. 1851.
(*v*) Casper's Wochenschrift, 1840, No. 8.
(*w*) Wibmer, Wirking, etc., iii. 149.
(*x*) Toxicologie, 5ème éd., ii. 804.

man, for a short period, of the right use of his senses, and render him oblivious of the external world.(*y*)

§ 605. VIII. *Lactuca. Lactucarium.*—The inspissated juice of two species of lettuce, the L. sativa and the L. virosa, has decided narcotic properties, and, in some experiments made by Orfila, the extract of the latter variety was fatal to dogs. No observations of its poisonous effects upon man have been recorded. Lactucarium is also known under the name of lettuce opium.

§ 606. IX. *Solanum.*—The *bittersweet*, or *woody nightshade* (S. dulcamara), is said to possess feeble narcotic properties. There is but little testimony to support this view. A case is recorded in Casper's *Wochenschrift*, in which a man took, in one forenoon, from three to four quarts of a decoction, made from a peck of the stalks, and was attacked with pain in the joints, numbness of the limbs, dryness of the mouth, and palsy of the tongue, the consciousness was unimpaired, the pulse quiet, but small and rather hard, and the skin cool. The symptoms disappeared under the use of stimulants.(*z*) Orfila relates an instance in which three children were poisoned by the berries of the S. nigrum, the common garden or deadly nightshade. One of them died, and all of them exhibited symptoms analogous to those produced by belladonna. The supposed active principle of these plants is called solania, or solanine, and is found also in the young shoots of the common potato, S. tuberosum, but not in the tuber itself. In some experiments by Dr. Fraas, the effect of this alkaloid upon animals was very variable, when administered by the mouth or rectum. Those in which it was injected into the veins we do not consider as conclusive. Two grains of acetate of solanine injected into the rectum of a rabbit, produced heaviness, apathy, *dilatation* of the pupils, convulsions, and death in six hours; but twenty grains of pure solanine given to a pig, and five grains to a dog, produced little or no effect.(*a*) Schroff,

(*y*) Schneider, in Henke's Zeitschrift, 1848, 4, H. p. 520; see also Bayard Taylor's Travels in Palestine, etc., for an amusing account of its effects.

(*z*) Lond. Med. Gaz., Sept. 1850, p. 548.

(*a*) Brit. and For. Med.-Chir. Rev., July, 1854.

however, distinctly states that this alkaloid has no influence upon the size of the pupil.(*b*)

X. *Datura Stramonium.* (Jamestown Weed.)

§ 607. 1st. *Nature and effects.*—All parts of this plant are poisonous, but the seeds and the leaves are most frequently employed. In some countries it has been and is still now used for the purpose of producing intoxication, with unconsciousness, in order to facilitate the perpetration of criminal designs. It has been thus given infused in wine or mixed in food. Poisoning by other species of datura is very common in India. During the year 1848, there were treated for it at the Native Hospital, in Bombay, forty-nine males and two females. The powdered seeds are there employed, concealed in rice or other grain. In many cases three stages of symptoms are observed —delirium, sopor, and coma; in others delirium only is observed. The primary delirium may be vociferous or merely garrulous, the patient usually manifesting excessive timidity. In both this and the soporific stage he is constantly engaged in picking at real or imaginary objects, and sometimes in performing such antics as to render laughter on the part even of friends unavoidable. Dr. J. G. Johnson reports the case of a boy in whom the movements were like those observed in chorea.(*c*) Several of the movements seem to depend upon perverted vision, which destroys the power of judging of the distance of objects, and which may be due to the widely dilated pupil, a persistent symptom. Husemann observed a case of poisoning by this plant, in which all black objects appeared to the patient green.(*d*) In other cases there is complete blindness. The pulse and temperature, although usually natural, undergo in some cases extremes of exaltation and depression. On recovery, the person usually recollects nothing since the meal at which he was poisoned, so rapid are its effects.(*e*) Dr. Duffin, of London, reported the case of his own child, two years old, who died in twenty-four hours after

(*b*) Lehrbuch d. Pharmakologie, S. 553.
(*c*) Am. Med. Times, i. 22. (*d*) Journ. f. Pharm., ii. 191.
(*e*) Brit. and For. Med.-Chir. Rev., Jan. 1851.

swallowing one hundred seeds, without chewing them. She became fretful, and like a person intoxicated; in the course of an hour efforts to vomit ensued, together with flushed face, dilated pupils, incoherent talking, and afterwards wild spectral illusions and furious delirium. In two hours and a half she lost her voice and the power of swallowing, evidently owing to spasms of the throat. Then croupy breathing and complete coma set in, with violent spasmodic agitation of the limbs, occasional tetanic convulsions, warm perspiration, and a scarcely perceptible though not frequent pulse. In other cases the pulse was full and slow, and the general symptoms those of ordinary intoxication, with this remarkable exception of the slowness of the pulse. In a case related by Boerhaave, and in others reported in this country, a scarlet eruption appeared on the face.

Accounts of poisoning, one by the infusion of the leaves, and the other from eating the seeds (which have not a disagreeable taste), may be found,(*f*) in which great stress is laid upon the eruption, "somewhat like that of *urticaria*," which appears as one of the toxic symptoms, and varies in intensity with the severity of the symptoms. In females it has produced nymphomania. Kurzak observed priapism of an hour's duration in a case of poisoning with stramonium-seeds.(*g*) Dr. Bobierre, professor of chemistry at Nantes, drank by mistake a small quantity of an infusion of the leaves and seeds. In a quarter of an hour he began to feel heavy, and he had an uncomfortable feeling of constriction in the neighborhood of the larynx. His pupils were dilated, and the secretion of saliva, perspiration, and urine was entirely suppressed.(*h*) The external application of the bruised leaves may give rise to the symptoms of poisoning. An overdose of the officinal extract has produced fatal effects. The active poisonous principle resides in the alkaloid, *daturia;* this, when placed on the eye, dilates the pupil, and the eighth of a grain has killed a sparrow in three hours.

(*f*) Boston Med. and Surg. Journ., Aug. and Oct. 1872, pp. 81 and 240.

(*g*) Schroff, Pharmacol., p. 532.

(*h*) Journ. de Chim. Méd., 1851, p. 539; *vide* also Charleston Med. Journ. and Rev., Nov. 1854.

§ 608. 2d. The *post-mortem appearances* after poisoning with stramonium-leaves or berries present nothing which can be fairly attributed to the poison. In the cases which have been examined there has been but a very slight deviation from the natural condition.

XI. *Nicotiana Tabacum.* (Tobacco.)

§ 609. 1st. *Symptoms.*—The symptoms produced by a poisonous dose of tobacco, are nausea, vomiting, a burning heat in the throat and stomach, colic, diarrhœa, urination, extreme giddiness, great anxiety, with a disposition to faintness, pallor, coldness of the extremities, spasmodic trembling; the pulse is small, weak, tremulous, and intermittent; the breathing labored and stertorous; there is a paralytic relaxation of the voluntary muscles, and clonic spasms of the limbs. The pupils are but slightly affected, and the eyes seem to be sensible to light. This state is succeeded by a general torpor, or utter prostration, which is not coma, but which may terminate in death. Tobacco has produced death by having been criminally mixed with liquor. The dose capable of destroying life, when introduced by the mouth, is not known.

Two cases are related by Dr. Deutsch, in which life was in extreme danger from the swallowing of tobacco. In one, a soldier suffering with the tapewòrm, took, by the advice of a friend, some of the extract of tobacco, such as is deposited in smoking-pipes. The quantity swallowed was estimated at an ounce. He was at once seized with the most horrible pains in the stomach, and fell into a state of extreme collapse. The efforts to vomit were ineffectual until an emetic was given to him. After extreme suffering, he slowly recovered. In the other case, a young lady accidentally swallowed the still lighted stump of a cigar which she had been smoking, and suffered greatly from the ordinary symptoms of poisoning by tobacco, together with pain in the stomach, until she was relieved of it by vomiting. A fatal case is reported by Mr. Skae, of a man who swallowed a large mouthful of crude tobacco. In addition to the usual symptoms, he had convul-

sions.(*i*) A further variation from the ordinary course of symptoms was shown in the case of two females, about eighteen years of age, both of whom drank an equal quantity of a decoction of tobacco. The one was affected in the usual manner, the other became insensible and was attacked with convulsions; her arteries and veins were distended, and the former throbbed forcibly, and the conjunctiva was injected.(*j*)

Dr. Weaks, of Vermont, mentions the case of a child a few days old, to whom two tablespoonfuls of water impregnated with the smoke of tobacco were given, for the purpose of keeping it quiet. It died comatose in eight hours, notwithstanding the most active efforts for its resuscitation.(*k*)

§ 610. Pereira quotes from Dr. Copland an instance in which half a drachm administered by enema proved fatal, other cases in which one and two drachms had the same effect. In one of these referred to by Dr. Christison, death occurred in thirty-five minutes. Dr. Tavignot witnessed a fatal result in the case of a robust man fifty-five years of age, who took an enema prepared from fifteen grains of tobacco.(*l*) Dr. Eberle knew the life of a boy destroyed in less than twenty minutes by a tobacco enema.(*m*) Several instances also are recorded in which the external application of moistened tobacco leaves produced alarming symptoms or death. Two also are said by Gmelin to have resulted from excessive smoking, in one case seventeen, in the other eighteen pipes having been smoked at a sitting.

§ 611. 2d. The *post-mortem appearances* are by no means characteristic. In a case minutely described by Dr. Grahl, of Hamburg, the only appearances at all unusual were a diffuse redness of the omentum, and of the outer and inner coats of the intestine, and patches of extravasation in some portion of the mucous membrane, together with an empty condition of the vessels of the abdomen and of the heart.

Where a large quantity of snuff has been taken into the stomach, portions of it may remain entangled in the mucus,

(*i*) Edinb. Med. Journ, i. 643.
(*j*) Dierbach, Neueste Entdeck., ii. 884.
(*k*) Boston Med. and Surg. Journ., vol. xlvii. p. 461.
(*l*) Rev. Med., Nov. 1840. (*m*) Therapeutics, p. 889.

and thus be recognized either by its physical characters or on chemical analysis, by the active poisonous principle called *nicotine*, or *nicotia*. In Dr. Weaks' case, no odor of tobacco was perceived on opening the body.

§ 612. 3d. *Nicotina, or nicotia.*—This alkaloid has much interest attached to it from its having been the poison used by the Count of Bocarmé in the murder of his brother-in-law, Gustave Fougnies.(*n*) The nicotina was obtained by Professor

(*n*) On account of the great interest which this trial excited, we have subjoined the following succinct history of the case, as presented by the Attorney-General of the Court of Appeals of Brussels.

ACT OF ACCUSATION.

The Attorney-General of the Court of Appeals of Brussels represents that the court, by a decree of the 16th April, 1851, transmitted to the Court of Assizes of the province of Hainaut the names, first of Alfred Julien-Gabriel-Gérard-Hyppolite Visart, Count of Bocarmé, aged thirty-two years, landholder, born at the Camp of Weltevreden in Java, etc.; second, of Lydia Victoire-Joseph-Fougnies, aged thirty-two years, wife of Count Bocarmé, born at Péruwelz, and both living at Bury, accused of the crimes enumerated in the articles 301, 302, 59 and 60 of the penal code.

In consequence, the attorney-general has drawn up the present act of accusation, in which the following facts and details are set forth :—

The Count Hyppolite Visart de Bocarmé, belonging by birth to one of the first families of Hainaut, married, in 1843, at Péruwelz, the daughter of an ex-grocer who had two children, and whose son, having lost his right leg by amputation, had not a very strong constitution. The accused, therefore, even before the contract of marriage, foresaw that the end of Gustave Fougnies, his brother-in-law, was more or less near; and after having secured to himself the property of his wife by will, he did not hesitate to consult Dr. Semet regarding the chances of life or death which Gustavus might have.

But Gustavus also began to think of marriage. He had already entertained the idea in 1846, and he was on the point of carrying it into execution, in the month of November last, when he died suddenly at the mansion of Bitremont, where the prisoners resided, and in the very apartment where he had been dining with them. They communicated the intelligence the next day to Madame Dudzeele and her daughter, to whom Gustavus was about to be married; and the Countess herself charged a servant to "go and tell the two hussies that her brother had died of apoplexy." But the state of the body indicated a very different kind of death, since the autopsy disclosed upon the anterior part of the nose a deep contusion, upon the left cheek a number of scratches, which appeared to have been made by the finger nails; over the left maxillary region there was a corrosion involving the cuticle, and which seemed to have been caused by some caustic fluid; in fine, upon

Stas from the mouth and stomach of the deceased, and from articles of clothing and furniture. It had been prepared by

the tongue, in the mouth, throat, and stomach, there were numerous traces of the passage of a similar substance.

The physicians (experts) concluded from these observations that a corrosive liquid had been poured during life into the mouth of Gustavus Fougnies, and had produced a cauterization of the whole of that cavity and part of the pharynx; that a portion of this liquid, either spilt or rejected, had burned the left side of his neck; and that the marks of violence on the face proved that efforts had been made to force down the liquid, and to stifle the cries of the victim.

Moreover, the Count presented upon the second phalanx of the middle finger of the left hand, two wounds, which involved the skin, and which were evidently the result of a bite, for the marks of two teeth were visible in the lower wound, which was deeper than the other.

At the time the investigation took place, on the 22d November, at the chateau of Bitremont, there was also apparent upon his fingers and under his nails a red discoloration, which was only too evidently connected with the scratches of which the face of Fougnies offered numerous traces. All this required an explanation, which was far from being satisfactory; and chemical analysis speedily demonstrated that Gustavus Fougnies had been poisoned by nicotine, a narcotic alkali, extracted from tobacco, and which is one of the most deadly poisons. The prosecution was prepared to show that the accused had for ten months previously made this poison a particular study; that he had, some days before the death of Gustavus, procured by his labors two small phials of it, which, since that event, have not been found. Moreover, the Countess herself formally accused her husband of having poisoned her brother; and although the Count himself now acknowledges that he extracted the nicotine which destroyed Gustavus, without, however, explaining by whose means it had been administered, we think it may be useful to present a summary of the facts which instigated, preceded, accompanied, and followed the crime on the 20th of November.

In marrying Lydia Fougnies, whose patrimony he had over-estimated, Count Bocarmé was far from gaining an opulent position, since he only received from his father-in-law a yearly allowance of 2000 francs, and he brought on his own side 2400.

Such feeble resources did not well accord with so grand a domestic establishment, with numerous servants, and especially with the irregularities of the accused, who in a short time had a second household in the environs of Brussels. He therefore found himself obliged to resort to daily loans from his notary, to whom he owes nearly 43,000 francs; and although M. Fougnies, the father, died in 1845, leaving his daughter a revenue of 5000 francs well secured, this increase of fortune was far from assuring the future of the accused, since their expenses were every day increasing, and they had even drawn since 1846, without repayment, to the amount of 95,000 francs.

All this did not prevent them from owing dribbling debts to the amount of

the hands of the murderer himself, who had devoted several months to the study of the process of eliminating it from

7000 francs, some of which dated back to the same epoch, and in which we see domestics or mere journeymen figure for sums of thirty, twelve, ten, and three francs. In fine, they had so completely lost their credit, that the Count was reduced to pledge for 400 francs, at a pawnbroker's in Brussels, ornaments belonging to the Countess, and which are still there. The ruin of the accused was thus imminent, unless the death of Gustavus, on which they had so long counted, should occur, to re-establish their dilapidated fortune.

But Gustavus did not die; he had even formed new projects of marriage, which seriously vexed the accused, and which they sought to break, by means of the notary, Cherquefosse. The Countess herself had written to her brother two letters, which were found after his death, and which contained some slanders against Miss Dudzeele, which she had used in an anonymous letter of the month of August. These attempts, however, had resulted in nothing, and there only remained to the Count the last resort, and the most efficient means for attaining his end.

After having cultivated poisonous plants in 1849, he presented himself, in the month of February, 1850, under the assumed name of Bérant, before Löppens, Professor of Chemistry at the Industrial School of Ghent, and begged to be informed of the proper apparatus for extracting the essential oils of plants, remarking that he had seen the American savages poison their arrows with the juice of certain plants, and that he wished to make some experiments for the benefit of his parents, who lived in the United States. He consulted Löppens particularly with regard to the mode of distilling the essential oil of tobacco, that is to say, *nicotine;* and he ordered from the brazier, Vandenberghe, according to the instructions of the professor of chemistry, an apparatus of brass, which he wished to be ready by the 11th of March.

On his return to Ghent, in the month of May, the accused showed Löppens the first sample of nicotine, which had not proved efficient. He then recommenced the operation under his supervision, and after having labored two days in his laboratory, he succeeded in obtaining two drops of pure nicotine.

He returned again, after some time, with another sample, which had not succeeded any better than the first. Löppens then gave him new instructions; and the accused announced to him at last, on his third visit, in the beginning of October, that he had obtained the most deadly effects on animals.

Nothing now remained but to procure the necessary substances and instruments to operate on a larger scale, and to follow the procedure of Schlœsing, which Löppens had pointed out as the best, and which Pelouze and Frémy describe in their course of General Chemistry.

But these purchases made new journeys to Brussels necessary, which the accused visited on the 16th and 28th of October, and after laboring without interruption two days and two nights, he at length succeeded, on the 10th of November, in obtaining two phials of nicotine, which he was to employ on the 20th, and which could not be found after the death of Gustavus. With

tobacco. The *symptoms* produced by it in the human system are not well known. Besides the one already referred to,

regard to the chemical instruments which had served for its preparation, the Count had taken care that they should immediately disappear. The servants of the establishment could give no information with regard to them, and it was not till six weeks after that they were discovered in a secret place, where the Count had mysteriously concealed them.

This precaution, all will agree, does not well accord with scientific labors, or with researches made for the benefit of another continent.

There is, moreover, the false name of *Bérant*, which the Count always assumed in his interviews with Löppens and Vandenberghe, although he did not conceal his true name at the pawnbroker's shop in Brussels. We may then safely conclude that he had already, in the month of February, meditated the crime which he committed in the month of November, and of which his own mother would seem to have had a presentiment, since she said one day to her daughter-in-law, that Hyppolite was capable of anything, that he might do some mischief by his chemistry, and that she expected nothing else but to see him some day brought before the Court of Assizes. The diligence with which he labored night and day, moreover, clearly indicated the object he had in view, especially at the period when the idea of marriage had taken possession of Gustavus, and the Countess herself had avowed the object, since she said in so many words, at one of her examinations, "My husband speculated on the death of Gustavus; it was his fortune that he coveted—it was that which made him decide upon his death; he had lived too long, in his estimation. During the first days of November, I knew that the poison was prepared for Gustavus; I knew, moreover, that the poison was nicotine. My husband himself told me this in the rear wash-house, the day I saw the large matrass in the vessel of oil, and where he told me he made cologne water. I used many entreaties to know what he was really making, and he at last admitted that it was nicotine. Some days after, he told me, that the first time an opportunity presented, he would not miss Gustavus; and on the 20th of November, on learning that he was coming to Bitremont, he declared to me," added the Countess, "that he would do the business for him that day."

Gustavus, in fact, arrived at ten o'clock; it only required a single word to save him, and yet the Countess passed the whole day with him without informing him of the dangers which impended. She even gave orders which would insure the execution of the crime, by removing those whose habitual presence would have prevented it. Thus, she made the oldest of the children, and his governess, dine in the room of the latter, instead of admitting them to her own table where they dined every day, and she had caused supper to be prepared for the two smaller children in the apartment of the nurses, instead of in the kitchen as was their custom. It is true that one can hear from the kitchen what passes in the dining-room. She also sent her coachman, Vandenberghe, to Grandmetz, with a letter to the ladies of Dudzeele, although he had, by the arrival of Gustavus, an additional horse to take care of, and although the letter had no other object than to inquire of the ladies what

there is but a single case upon record, and in that, also, the symptoms were not witnessed. From the circumstances it

price they would ask for their agricultural implements. There was no urgency in the message, but the distance to travel over required the absence of the coachman for four or five hours; and when afterwards the Countess ordered her chambermaid, Emérance Bricourt, to serve at table instead of Vandenberghe—she was careful to order her to withdraw after the second service. Emérance did not again appear in the dining-room until the time when she supposed they would need a light, and the accused, to whom she came to offer it, answered both at the same time, "*No, no, not yet.*"

On withdrawing, Emérance was going to the kitchen, where the coachman was dining, who had returned from his trip to Grandmetz. The Countess followed her and saw her go up to the nursery, where she found the two nurses, Justine Thibaut and Virginia Chevalier. She had also ordered Vandenberghe to accompany, as far as the road to Leuze, a distance of about one kilometre (nearly equal to three-quarters of an English mile) the cook, Louisa Maes, who was returning home. Vandenberghe had set out on the road with Louisa, but he was not long in perceiving that it would be too late for the girl to travel alone, and, as she had no money to pay for lodging on the way, he had returned with her to the house, and informed his master and mistress, who were still in the dining-room with Fougnies. Gustavus had already manifested an inclination to leave. The Count had even ordered Francis Deblicquy, the gardener, to get the carriage ready, but the stable was locked, and Vandenberghe had the key. He had scarcely returned to the house, when the Count went to the kitchen to give the same orders which he had given to Deblicquy. The coachman then took the lantern and went to the stable, and the Count returned to the dining-room.

Justine Thibaut was coming down stairs at this moment to get some supper for the children, although the Countess had ordered them away from the kitchen on this occasion, as already stated. Arriving upon the last steps of the stairs, she heard a fall in the dining-room, and the voice of Gustavus, who cried for help, exclaiming "*Oh, oh, forgive me, Hyppolyte!*"

She then ran to the kitchen, crossing the office which separated it from the vestibule and dining-room, when she saw the Countess go out of the dining-room and enter the office, closing the doors of the two apartments, so as to prevent the cries of Gustavus from reaching the kitchen. The girl, being still more frightened at this sight, hastened to reach the court by a circuitous way; she then passed opposite the windows of the dining-room, from whence issued stifled cries, and went up to the children's apartment by the old back stairway. Emérance, whom she found there, then went down to offer her services; but she heard no more noise, and the Countess made her go up again on seeing her at the bottom of the stairs.

The marks of violence observed upon the body exclude the idea of accident or of suicide. They prove, on the contrary, a violent struggle; and, when we reflect, that, to make the victim swallow the poison, it was necessary at the same time to open his mouth and restrain the movements of his head to

was inferred that the person became suddenly insensible and powerless, and died in from three to five minutes.(o) In ex-

the right and left, which he would otherwise make, it is nearly impossible to admit that the crime was the act of one person only.

How, indeed, can we conceive that the Count Bocarmé, whose left hand, imprinted with a double bite, was held in the mouth of Gustavus, and whose right hand was fully employed in steadying the head and arms, could of himself, and without foreign aid, pour into his mouth a phial of nicotine?

Another person was, therefore, necessarily a participator in the act, and there were only the Count and the Countess in the dining-room at the moment when Justine heard the fall and the cries of Gustavus. The accused wrote as follows, on the 12th of last March, to a correspondent in Paris: "My wife has requested you to engage M. Berryer: do not do it; and, if the engagement is made, suspend it until a new order is received from me, but let her continue in the belief that he is engaged. On this recommendation, both her life and mine depend. Only imagine that this wretched woman, after having poisoned her brother, can find no better defence now, when we are both in prison for the deed, than to charge the whole upon me, and to accuse me of the most atrocious crimes. Do not answer this note, which I secretly slip in the accompanying letter. Remember, that all the letters we receive are opened. If Berryer shall have engaged to come, explain to him what I have stated to you in this note; show him that the hostile attitude assumed towards me by my wife, is only the result of a moral constraint, occasioned by the position in which she finds herself placed, and that his aim should be to defend us both equally against the accusation, and not to take up for my wife the hostile position she has assumed in regard to me; this would give great plausibility to the charge, and lead us inevitably to the scaffold."

This note, which the accused had fraudulently slipped into a letter, intended to be shown, was not for the Judge of Instruction. It expressed then the secret thoughts of Count Bocarmé better than they were ever explained in his interrogations; and those thoughts entirely agree with the nature of the crime of which he is accused; it also well agrees with the disclosure the prisoner had made to the keeper of the prison, since he told him, on returning from his first examination, that it was the Countess who had turned the poison into the mouth of Gustavus; that she had made two different attempts in doing it, and had even spilt it on the clothes of her brother.

This explains why she went, a few minutes afterwards, to wash her hands with soap in the kitchen; why she immediately placed the clothes of Gustavus, and those of her husband, in a wash-tub full of water; why she caused them to be wrung and washed in lye, at midnight, in her presence, by the cook, L. Maes. This also will explain why she caused the crutches of her brother to be washed with hot water; why she even caused them to be burned, saying that she could not bear the sight of anything that had belonged to him; why she had burned his waistcoat and cravat, at the very

(o) Times and Gaz., June, 1858, p. 659; Guy's Hosp. Rep., 3d ser. iv. 345.

periments upon dogs, Orfila observed that vertigo was first produced, that they then sank down, had tetanic convulsions,

moment the officers of justice arrived at Bitremont. This will also serve to explain why she caused the floor of the dining-room to be washed the same night, and in her presence; why, the next day, she herself poured oil upon the spots, that they might not be recognized; and why she said, with evident satisfaction, to Emérance, at the time they were making the autopsy, that everything went on well, and that they had discovered nothing, and would bury Gustavus on the morrow.

These facts are too numerous and too direct for any one to doubt of her being an accomplice, especially when placed in connection with the extraordinary declarations of her husband, with the special character of the crime, and with the measures the Countess had taken to insure its execution. This complicity dated as far back even as the time when she had written, and signed with the false name of *Bérant*, all the letters addressed to Lōppens, and the brazier, Vandenberghe; and she had even counterfeited his handwriting in several of these letters.

The Countess alleges, it is true, that if she passed the night in effacing the traces of the crime, it was only to save her husband and the father of her children. But it is very difficult to admit the excuse in regard to so odious a crime, and one, too, committed against her own brother.

Especially it is difficult to admit it in connection with the almost daily acts of violence which the Countess had to complain of, and to which her husband added the grossest immorality, since we have seen that he obliged her to receive the fruit of his adultery at the château of Bitremont.

She also maintains, that if she concurred in preparing for, or aiding the poisoning, she had only done it under the threats of her husband, and under the influence of moral constraint. But then, why did she not at least apprise her brother, when a single word might have saved him? Why did she profane his dead body, by ordering the coachman, Vanderberghe, to deluge it with vinegar? Why apply an approbrious epithet to the ladies Dudzeele, when she directed a servant to inform them of the death of Gustavus? All this denotes too clearly a common purpose to attain the same object, which might profit both the accused, and which even the uncle of the Countess openly proclaimed in his deposition, explaining the reasons why he had not been present at the house the next day, in compliance with the invitation he had received. "I was," he said, "too indignant against them on account of their infamous conduct, and this indignation has its foundation in my deep conviction that they murdered Gustavus."

In conclusion, Alfred Gabriel Gérard Hippolyte Visart, Count Bocarmé, and Lydia Victoire Joseph Fougnies, wife of Bocarmé, are charged with having wittingly made an attempt upon the life of Gustavus Fougnies, their brother and brother-in-law, at Bury, on the 20th of November, 1850, by means of substances which would cause death more or less promptly, or at least with having been accomplices in this act, whether they gave instructions to commit it, or procured the substance, or did any other act to carry it into

with opisthotonos, and died in a variable time, according to the strength of the liquid. Anhydrous and pure nicotina, he says, may kill a dog in half a minute, but two minutes are usually required. If somewhat less pure and more diluted, death will follow in about ten minutes, and if still further diluted, the animal may recover. The doses given were from one to twelve drops.

§ 613. Nicotina is an oily, transparent, colorless liquid, becoming brown and thick upon exposure to the air, and, when pure, exhaling a *slight* smell of tobacco. Its taste is acrid and burning. The vapors that are given off when it is volatilized at 200° have so strong an odor of tobacco, and are so irritating, that, according to Orfila, it is difficult to bear them. Nicotina is soluble in alcohol, water, ether, and the oils.

The tests of nicotina are thus stated by Dr. Taylor:(*p*) It precipitates yellow with chloride of platina, white with corrosive sublimate, bright yellow with arsenio-nitrate of silver, reddish-brown with iodine water, yellowish-white with tannic acid, and does not affect a solution of gallic acid.

§ 614. It may be sought for in the viscera of a person poisoned by tobacco, in the following way. After the suspected substances have been macerated in water acidulated with sulphuric acid for twelve hours, this should be filtered, evaporated in closed vessels nearly to dryness, treated with a little distilled water to dissolve the sulphate of nicotina, then neutralized with potash and distilled over. Or, instead of this latter stage of the process, the solution holding the sulphate may be treated with ether, decanted, and allowed to evaporate. The residue will be nicotina. It has been detected by Orfila

execution, knowing the object intended; whether they knew of, or aided, or assisted the author or authors in, those acts which prepared for or facilitated the deed, or those which consummated it.

Regarding which, the Court of Assizes of Hainaut will decide.

For the Procureur-Géneral,

May 3d, 1851. (Signed) E. D. CORBISIER, Substitute.

The discussions respecting this case occupied the court during twenty-one sittings (from May 27 to June 15). M. Bocarmé was found guilty by the jury, and condemned to death; and Madame Bocarmé was acquitted.—*Procès du Comte et de la Comtesse de Bocarmé.* Paris, 1851.

(*p*) Guy's Hosp. Rep., 3d. ser. iv.

in the bodies of animals destroyed by it, two or three months after their death. The process employed by Professor Stas has been, in its preliminary steps, explained in the chapter on OPIUM, § 555.

§ 615. The subsequent steps applicable to the discovery of *any* of the *liquid* and *volatile alkaloids* may be here briefly quoted. "By the evaporation of the ether, there remain in the inside of the capsule some small liquid striæ which fall to the bottom of the vessel. In this case, under the influence of the heat of the hand, the contents of the capsule exhale an irritant, suffocating odor more or less disagreeable; it presents, in short, a smell like that of a volatile alkali masked by an animal odor. If we discover any traces of the presence of a volatile alkaloid, we add then to the contents of the vessel, from which we have decanted a small quantity of ether, one or two fluidrachms of a strong solution of caustic potassa or soda, and agitate the mixture. After a sufficient time we draw off the ether into a test-tube, exhaust the mixture by two or three treatments with ether, and unite all the ethereal fluids. We afterwards pour into this ether, holding the alkaloid in solution, one or two drachms of water acidulated with a fifth part of its weight of pure sulphuric acid, agitate it for some time, leave it to settle, pour off the ether swimming on the top, and wash the acid liquid at the bottom with a new portion of ether." The sulphate of nicotina, as well as some others, being entirely insoluble in ether, a pure sulphate is contained in the water. The alkaloid may be now set free by caustic ammonia, and agitation with ether. The ether may be left to spontaneous evaporation, and the last traces of ammonia removed by placing the vessel containing the alkaloid in a vacuum over sulphuric acid. The organic alkaloid being thus isolated, it is the duty of the chemist to determine, if possible, its real nature. This was the process used by Prof. Stas for the separation of *nicotina* in the Bocarmé trial, and also in experimental researches upon animals.(*q*)

(*q*) Am. Journ. of Pharm., Jan. 1853.

XII. *Conium Maculatum.* (Common or Spotted Hemlock.)

§ 616. 1st. *Its action.*—The poisonous properties of this plant reside chiefly in the leaves, but exist also in other parts. The accounts of its action upon the human system are somewhat contradictory. Some authors attribute to it positive narcotic properties; Orfila quotes the case of a soldier, who, having eaten of some broth into which hemlock had been put, went to sleep immediately after his supper. A couple of hours later, he was found still lying on the ground in a profound sleep, insensible. His pulse was extremely slow, the extremities cold, the face swollen and livid, and the respiration labored. He died in three hours. Some cases are related in which delirium and fatal convulsions were said to be due to this poison. On the other hand, these symptoms are not produced by conia, which is supposed to be the active poisonous principle of the plant, nor do they agree with the observations of other authors, especially of recent date. Dr. Pliny Earle tried the effect of the extract of conium upon himself. The preparation seems to have been a feeble one, for although the dose was steadily increased until it reached sixty grains three times a day, and seven such doses were taken, the effects were by no means striking. No soporific effect, however, resulted; he experienced merely the sensations of fulness of the head and eyes, a "tendency to vertigo," double vision, and a great feebleness in the limbs.(*r*)

§ 617. 2d. *Symptoms.*—Dr. Hosea Fountain, however, who prepared for himself an extract from the fruit or seed of the plant, and took twelve grains of it, began to experience its effects in half an hour. He had a feeling of lightness in the head, dimness of vision, and *muscæ volitantes*, before his eyes; "very soon," he says, "a numb, pricking sensation was felt in the fingers, extending gradually to the elbows, producing a stiffness of the muscles of the parts, making it difficult to move the forearm and hand. In a few minutes the same sensation was observed in the feet, creeping slowly upward, until it reached the upper part of the thigh. The eyes now began

(*r*) Am. Journ. Med. Sci., July, 1845.

to feel uncomfortable, causing me to brush them frequently, to clear apparent obstructions from the lids. The pulse was soft and feeble, but not more frequent than usual." Having dismounted from his horse, he found so much difficulty in walking that he required assistance, and the lower limbs appeared to be nearly paralyzed. This partial paralysis of the limbs continued throughout the whole day, although the head symptoms disappeared under the influence of tobacco and rest. No *soporific* effect was produced.(*s*)

In an undoubted case of death from eating hemlock, the symptoms were very much like those just described. The man's consciousness and intelligence were not affected, but he lost his sight completely, and was unable to walk. He seemed also to have lost all muscular power in his arms, and the power of deglutition and speech; several efforts were made to vomit, but they were ineffectual. His pulse and breathing were perfectly natural, as well as the heat of skin. Death ensued in three hours after eating the poisonous plants, without convulsions, but apparently from paralysis of the heart.

The post-mortem appearances in this case were not important except the presence of numerous extravasations of dark-red blood below the epithelium of the mucous membrane of the stomach. The stomach contained a pultaceous mass formed of a raw greenish vegetable resembling parsley. Its contents weighed eleven ounces and had an acid and slightly spirituous odor. The hemlock leaves were identified by their botanical characters, and by the peculiar musty odor of *conia* which was strongly evolved, on bruising some of the leaves in a mortar, with a solution of potash.(*t*)

3d. The *hemlock water drop-wort* (Œnanthe Crocata) is a still more energetic poison than the foregoing, but from not being medicinally used does not require notice here. Many accidents have happened from the roots of this plant having been eaten in mistake.

§ 618. 4th. *Conicine*, or *conia*.—The active principle of common hemlock is a most virulent poison and a local irritant.

(*s*) Am. Journ. Med. Sci., Jan. 1846.
(*t*) Ed. Med. and Surg. Journ., July, 1845. J. H. Bennett.

A single drop applied to the eye of a rabbit killed it in nine minutes; and, when two grains of the muriate of conia were injected into the femoral vein of a young dog, it died before there was time to note the interval.(*u*) It produces paralysis almost instantaneously, but does not appear to interfere at once with the functions of the brain, since, according to Christison, the external senses are little, if at all, impaired, until the breathing is almost arrested; and volition too is retained. The blood undergoes no alteration.

§ 619. The effects of conium have been most thoroughly set forth by Dr. John Harley.(*v*) The following facts are recited by this experimenter.(*w*)

"The influence of conium appears to be in proportion, not to the *muscular strength* of the individual, but to his *motor activity*.

"1. The operation of hemlock in the same individual varies in degree according to his motor activity. A dose of conium, which in the ordinary condition of the patient shall be just sufficient to produce the peculiar effects of the plant in a mild degree, will, during the exhaustion following a profuse seminal discharge for example, operate much more decidedly and intensely. Again, the effect will be found to vary in proportion as the activity of the patient varies. Thus, in those whose bodily vigor declines as the day wears away, a dose which will be followed by no appreciable effect in the early morning will produce decided effects in the evening, and *vice versâ*.

"2. Those leading a sendentary, inactive life are more readily affected by conium than those of active habits. A delicate person of active habits will, therefore, bear a larger dose of hemlock than one possessing abundance of strength with but little energy.

"3. An active restless child will often take, with scarcely any appreciable effect, a dose sufficient to paralyze an adult of indolent habits; and such as would reduce a powerful muscular man to a tottering condition, and force him to assume a

(*u*) Christison.

(*v*) The Old Vegetable Neurotics, the Gulstonian Lectures of 1868. Macmillan & Co., London, 1869.

(*w*) Quoted from p. 13.

recumbent position, and retain it for a quarter of an hour or more. (See cases.)

"4. The same rule applies to children themselves; to produce a given effect, a dull inactive child requires only one-half the quantity that a lively active one does.

"Upon the cerebrum hemlock is powerless. I have induced its full physiological action again and again hundreds of times, in at least a hundred different individuals of all ages, and have never been able to recognize the least *narcotic*, nor directly *hypnotic*, effects. If sleep followed complete repose of the muscular system as a necessary consequence, then there would be no more powerful or direct hypnotic than hemlock. But other conditions over which this drug has no direct control are required to procure sleep. Under the influence of an effectual dose a child often presents the aspect of sleep. * * * But such an event will rarely happen to an adult. His mind will continue during the whole action of the hemlock as calm and active as was Socrates' when he said to his friend, 'Crito, we owe Æsculapius a cock; pay the debt, and do not forget it.' And he will tell us that he feels a strong desire to keep the eyes closed and remain quiet and undisturbed.

"In poisonous doses the eyes will be completely fixed and the pupils dilated; articulation and deglutition impossible; expression and all other power of motion gone, and yet, while there is every appearance of the most profound coma, the perceptive faculties and reasoning powers may be as acute as ever. Such a condition is, I believe, not an uncommon one in other states than that produced by hemlock. * * *

"I have observed that persons who use tobacco freely, usually require a large dose of conium to produce its physiological effects; and the reverse, that those cannot tolerate tobacco who are readily influenced by comparatively small doses of hemlock."

§ 620. The following plan is recommended by Orfila for its detection in food and other organic matters. The parts cut into small pieces should be placed in water acidulated with sulphuric acid, filtered, and evaporated by a gentle heat, after cooling, agitated with twice their volume of strong alcohol, then again filtered and evaporated until all the alcohol has

been dissipated. The fluid should, after cooling, be neutralized or rather rendered alkaline by soda, when the characteristic, mousy smell of conicine will be perceived. Being now agitated with sulphuric ether, and decanted, the conicine is left behind by the spontaneous evaporation of the ether, and may be distilled over chloride of calcium. Heated in a capsule it forms white vapors, having a strong smell of celery and the urine of mice.

The following process has been employed by Dr. Harley (x) for the recovery and detection of very small quantities of conia when mixed with organic matters. "The substance known or suspected to contain conia is comminuted and exhausted, after a few days' maceration in a percolator, by water acidulated with one-fiftieth of its bulk of sulphuric acid; the filtrate is spread out in a thin layer upon flat dishes, and allowed to evaporate to the consistence of a thin syrup in a warm, dry room, or at the distance of three or four feet before a fire; the residue is mixed with an equal bulk of strong solution of caustic potassa (one part to three of water), transferred to a long tube, and agitated with its bulk of ether several times during twenty-four hours. The ether is then decanted, and the alkaline mixture washed again and again with fresh portions of ether, until the conia is completely removed. Two, or at most three, washings are sufficient for this purpose. On distillation of the ethereal solution, the conia, more or less pure, remains. The impure conia is next shaken with a small quantity of dilute sulphuric acid, which separates the alkaloid from oily or resinous impurities. From this solution of sulphate of conia the base is separated in the usual way, viz., evaporation to a syrupy consistence, mixture with caustic potassa, washing the mixture with ether, evaporation of the ether, and finally distillation of the conia in a current of hydrogen, which may of course be omitted when we only want to determine the presence of conia. If spirit be used in the exhausting process, the ethereal extract will be contaminated by much fatty and resinous matters; hence the advantage of using a watery solution. In searching

(x) Op. cit., p. 80.

for conia in organic mixtures the same process may be adopted. The contents of the stomach may be digested for a few days with a sufficiently large quantity of sulphuric or oxalic acid, to prevent decomposition, then strained, evaporated spontaneously, and treated as above. Before we conclude that conia is present, we must isolate an oily matter which possesses, in addition to a conia odor, an intensely sharp biting taste, and which dissolves readily, with loss of odor, in a drop of dilute sulphuric acid. We must pour off this drop into a clean tube, and redevelop from it a strong conia odor by the addition of a little of a strong solution of caustic potassa. If we depend upon the odor alone we may fall into error.

Dr. Harley (*y*) relates a case in which it was impossible for him to distinguish in urine from patients, who had not taken conium, an ethereal extract treated with potassa from an aqueous solution of conia which he used for comparison. He mentions this fallacy in order to show, "that, in examining the animal fluids or tissues for conia, we must bear in mind that the addition of caustic potash to them will often develop an odor indistinguishable from conia, and that nothing short of the isolation of the principle itself should satisfy us."

Detection of conia in urine.(*z*)—About one part of a saturated solution of oxalic acid is added to four parts of the warm urine, and the mixture allowed to evaporate spontaneously. The brown syrupy residue should be separated from the crystalline matter, and both separately treated with excess of caustic potassa and then washed with ether.

These methods for the detection and recovery of conia were compared many times by Dr. Harley, and found to be quite reliable.

(*y*) Op. cit., p. 18.
(*z*) Harley, op. cit., p. 19.

CHAPTER X.

MISCELLANEOUS POISONS.

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§ 621. *Nux vomica.* 1st. *Qualities.*—Nux vomica and its chief poisonous alkaloidal principle may be conveniently treated of together. *Nux vomica* is a round flat seed about three-quarters of an inch in diameter, and two lines in thickness. It is covered with fine, silky, gray hairs, and is hard and difficult to pulverize. The powder is of a yellowish-gray color, and has an intensely bitter taste. *Strychnia* is usually seen as a grayish-white powder, inodorous, but excessively bitter. This property is so distinct that it is said that it may be perceived when only one part of strychnia is present in 30,000, or as others assert, in 600,000 parts of water. It is very sparingly soluble in water, but is easily dissolved by ordinary alcohol when boiling. It is deposited, however, upon cooling.

§ 622. 2d. The *symptoms* produced by strychnia or by nux vomica in poisonous doses are the following: The most prominent are spasmodic muscular contractions, which the slightest cause, such as a noise in the room, the contact of a person, or the attempt to introduce liquids into the mouth, is sufficient to excite. During these convulsions the limbs become perfectly rigid, the muscles tremble, the respiration is suspended, and the lips, tongue, and fingers become blue. The intellect is not affected, this drug seeming to exercise its influence upon the nervous centres, from the medulla oblongata downwards, alone. The fits succeed each other at short intervals, and death usually takes place during one of them, although it may occur after their cessation, from mere exhaustion. A well described case of accidental poisoning with strychnia, by Mr. Bennett,(*a*) would answer almost equally well for a picture of hydrophobia. The quantity taken was about a grain and a half in solution. The patient, when first seen, which was about an hour after the poison had been taken, was in a rigid and trembling state and the face almost maniacal in its expres-

(*a*) Lancet, 1850, vol. ii. p. 462.

sion. This was soon followed by a violent tetanic convulsion. Between the fits she did not utter any expression of alarm, but would occasionally request a little cold water. The muscles of the jaws remained so rigid between the spasms that the attempt to introduce the stomach pump was unsuccessful, and although some strong emetics were got down, it repeatedly happened that the attempt of the patient to take liquids was followed by so violent a spasmodic fit as to prevent her swallowing them, and to give that apparent dread of water so well marked in cases of hydrophobia. During the tetanic fits the whole body was stiffened and straightened; the neck violently drawn back, the chest fixed, the eyes protruding from their sockets in a horrible manner, the legs pushed out and widely separated, the muscles of the face convulsed, pulse imperceptible, and no breathing could be perceived; the face was livid, more particularly the lips, and froth issued from the mouth. The pupil was also dilated during the paroxysm. It was impossible to produce any relaxation of the body during a fit, and if moved the whole body maintained its rigid condition. As soon as death had taken place, which was in an hour and a half, the limbs relaxed, the face and lips gradually lost their livid hue and became, as well as the body, extremely pallid.

In this case alarming symptoms did not arise until about an hour after the poison had been taken, and numerous cases might be referred to in which an interval of an hour or two occurred. The poisonous effects of strychnia are more rapidly developed than those of nux vomica. But usually the former supervene very speedily, being seldom delayed more than fifteen minutes. Death may occur in fifteen minutes, as in the case of Dr. Warner, who was supposed to have taken only half a grain,(*b*) or in half an hour, as in a case reported by Dr. Theinhart, where thirty grains of strychnia were swallowed, and seldom is postponed for more than two hours, if no measures for the removal of the poison have been taken.(*c*) In a case that occurred near London, a prescription was improperly prepared, so that the young man, for whom it was directed, took a grain

(*b*) Phila. Med. Exam., Oct. 1847, p. 309.

(*c*) Am. Journ. of Med. Sci., Jan. 1848, p. 303, from Gaz. Médicale.

and a half of nux vomica, and the same quantity of strychnia. It is stated that "he soon afterwards complained of some extraordinary sensations, and *almost immediately* expired."(*d*)

§ 623. 3d. *Power.*—The smallest quantity of *nux vomica* which is known to have caused death, is said to be three grains of the alcoholic extract, but it is quite uncertain to how much of the powder this corresponds. Hoffmann (quoted by Christison) states, that two doses of the powder, of fifteen grains each, proved fatal, and other cases are related in which fifty and sixty grains produced death. The smallest quantity of *strychnia* which has proved fatal appears to be one grain.(*e*) In Mr. Bennett's case, above quoted, about one grain and a half was taken.

Recovery occasionally is observed, even after very large doses. Dr. Thomas Anderson records a case in which seven grains of strychnia were taken without producing fatal consequences.(*f*) The comparative mildness of the symptoms and the recovery throw some doubt upon the purity of the strychnia which was used. Dr. Dresbach, of Ohio, attended a man who drank, by mistake, three ounces of a solution of strychnia, containing one grain to the ounce. When seen by Dr. D., about twenty minutes afterwards, he was in the following condition: The whole muscular system rigid, the muscles of the back and legs so rigidly contracted, that it was with extreme difficulty the man was able to walk, face drawn awry and articulation impeded, a sense of burning about the stomach, tightness about the chest, vertigo and dimness of vision, lower extremities cold, and perspiration abundant. Chloroform being the only article at hand which seemed likely to be useful, Dr. D. gave the patient at once two drachms, and in less than fifteen minutes, the relief, Dr. D. says, was complete.(*g*) A case, in which a man recovered after swallowing a grain and a half, is reported by Mr. Foster.(*h*) In another case, a girl

(*d*) Am. Journ. of Med. Sci., April, 1854, p. 537, from Pharm. Journ., July, 1852.

(*e*) Med. Times and Gaz., April, 1855.

(*f*) Am. Journ. of Med. Sci., April, 1848, p. 562.

(*g*) Am. Journ. of Med. Sci., April, 1850, p. 546, from Western Lancet.

(*h*) Lancet, 1852, vol. ii. p. 198.

swallowed two grains of strychnia, upon an empty stomach. The poison remained in the stomach fifty minutes before it was removed by an emetic and the stomach-pump. The disturbance was slight, and the girl recovered. Dr. Taylor suggests, that, owing to the symptoms having been very slight in this case, the strychnia was probably not pure.(*i*) But recently other cases have occurred of recovery from still larger doses. In one, four grains were taken by mistake. Copious vomiting was produced by emetics in about a quarter of an hour, but the system was violently affected, there being not only excessive tetanic rigidity of the muscles, but frequently recurring convulsions, with other symptoms already detailed. The man recovered entirely in two or three days.(*j*) In another case, by Mr. Chippendale, a man who had been in the habit of using small doses for an imaginary spermatorrhœa, took four grains of strychnia, and four of morphia, in an ounce of spirit, with the intention of destroying himself. Tetanic spasms ensued in about half an hour; but in this, as in the preceding cases, the intellect remained unaffected—a fact the more remarkable, on account of the large quantity of morphia which had been swallowed. The latter produced none of its peculiar effects, except, perhaps, an itching of the skin, which occurred in the convalescence, and might perhaps be ascribed to it. The man recovered perfectly. The stomach-pump was used one hour after the poison had been taken, and water and animal charcoal injected into the stomach.(*k*) A case is reported by Dr. Bly, of a man who by mistake took four grains of strychnia at a dose. Tartarized antimony was immediately administered, but ineffectually, and tetanic convulsions and locked jaw succeeded. These symptoms were palliated by chloroform inhalations, so that an additional dose of tartar emetic could be administered. In thirty-five minutes after the poison had been swallowed the emetic operated freely, and, the anæsthetic inhalations having been continued, the threatening symptoms ceased in the course of seven or eight hours.(*l*) In this case

(*i*) Med. Times and Gaz., Ap. 1854.
(*j*) Ibid., Ap. 1855. G. Hinnell.
(*k*) Ibid.
(*l*) New York Journ. of Med., Nov. 1859, p. 422.

it is probable that the tartar emetic taken immediately after the poison hindered the absorption of the latter. Mr. Iliff has reported a case in which a female recovered after swallowing two drachms of powdered *nux vomica*.(*m*)

§ 624. *Poisoning by strychnia compared with tetanus.*—It must not be forgotten that it is not always an easy matter for a physician to distinguish between the effects of poisoning by strychnine and a disease called tetanus. A striking symptom in poisoning by strychnine consists in the sudden appearance of the convulsive spasms, and the rapidity with which the attacks and remissions succeed each other, and the short space of time which intervenes between the access of the spasms and a fatal result. We may also mention that the intervals between the spasms are marked by an absolute calm. In tetanus the rigidity of the affected parts is generally permanent, and the access, which is more prolonged than in poisoning, has more the character of paroxysm and of exacerbation rather than succession of attacks. Moreover the fatal result never happens in tetanus in two or three hours after the access of spasms, as has been noticed in strychnine poisoning. If there are examples of death almost as rapid, these are the results of traumatic rather than idiopathic tetanus. In the latter the duration is generally from two to ten days, and in every case exceeds that of strychnine poisoning, if death supervenes.(*n*)

§ 625. 4th. The *post-mortem appearances* are by no means characteristic, though certain negative results can be drawn therefrom which are not without value when considered in relation to the symptoms observed during life. It may be difficult to prove whether the pathological peculiarities in the autopsy of persons poisoned by strychnine may not have been indicated or are not characteristic of an affection of another condition. No notice should be taken of those cases in which there is no appreciable trace of pathological alteration of the organs; though this absence of lesion is not with-

(*m*) Lancet, 1849, Dec. 15.

(*n*) *Vide* an excellent account in Compendium de Chirurgie Pratique, A. Bérard et Denonvilliers, Paris, 1841, t. 1er, p. 350.

out value.(*o*) The most significant pathological lesions would be found in the nervous centres, but it must also be remembered that there are certain diseases in which identical changes have been observed. (Abercrombie.)

To some extent the degree of rigidity of the body, and the permanence of this condition, are peculiar.(*p*) In the case of Cook, poisoned by Palmer, Dr. Harland testified that the body was very stiff, more than dead bodies generally are. The muscles were very highly developed; they were strongly contracted and thrown out. The hands were firmly closed.(*r*) In another case, reported by Mr. Wilkins, it is stated that seven hours after death the rigidity of the body was so great as to allow it to be lifted by the heels; it is described as being "as stiff as wood."(*s*) In some cases there have been found signs of inflammation in the intestinal canal, and very generally congestion of the brain and its membranes, and sometimes softening of its substance and of the spinal marrow. The right cavities of the heart are usually contracted, and the blood dark and fluid. In some instances, no doubt, these appearances were due to cadaveric changes, and were not the result of any peculiar influence of the poison.

§ 626. 5th. *Strychnia, its chemical properties and tests.*—The crystals are elongated octahedral prisms. It is slowly dis-

(*o*) Tardieu, op. cit., p. 940.

(*p*) Until the researches of Brown-Séquard and others during the last few years it was supposed that this was a pathognomonic condition, but it seems now to be pretty well established that the condition of cadaveric rigidity depends upon a certain peculiarity of the muscular system, and that when death has followed the use of convulsifying poisons, the early and prolonged condition of the rigor mortis is due to the effects of the convulsions upon the muscular system. Now it is evident that in any case of death which has been preceded by violent muscular movements, this same early appearance of cadaveric rigidity may occur; whilst, on the contrary, if the convulsions have been prevented by the use of medicaments, or perhaps by artificial respiration (*vide* an article on Hydrocyanic Acid, in London Practitioner, for April, 1872), this post-mortem peculiarity might be absent. *Vide* Croonian Lecture, by Prof. Brown-Séquard, in Proceedings of the Royal Society. May 16th, 1861. Also Amer. Journ. of the Med. Sciences, Jan. 1870, p. 87 et seq.

(*r*) Times and Gazette, May, 1856.

(*s*) Guy's Hosp. Reports, 3d ser. iii. 484.

solved, and acquires a red color by the addition of strong nitric acid. The color is immediately destroyed by the protochloride of tin. Specimens of the alkaloid entirely free from brucia are not turned red by nitric acid. If a drop of a solution of chromate of potash be added to a solution of strychnia in sulphuric acid, the mixture acquires a beautiful violet color, which becomes darker on standing. If a grain of peroxide of lead be added to the solution of strychnia in sulphuric acid, brilliant colors are produced, which pass through various shades of blue, red, and yellow.

The following process for the detection of strychnia in mixed fluids was devised by Prof. Graham and Dr. Hoffmann, for the purpose of testing the presence of this poison in the bitter ales of Burton.(*t*) It may be also applied to other liquids. Two ounces of animal charcoal are to be shaken in about half a gallon of the suspected fluid, and this is to be left at rest for a night, and then filtered through paper. The fluid is thus deprived of its bitterness. The charcoal which contains the strychnia is then to be boiled for half an hour in eight ounces of rectified spirit, and the spirit, after being filtered, is concentrated by distillation. The remaining liquor, which is watery, is next decomposed with a few drops of solution of potash, and agitated with an ounce of sulphuric ether. The ether contains the strychnia in a state of considerable purity, and, on being evaporated, it deposits a white soluble matter, of intense bitterness. If a drop of sulphuric acid be placed upon this residuum, and then a fragment of bichromate of potash, in the resulting liquid a beautiful violet tint appears at the points of contact, and soon spreads over the whole fluid. This change of color seems to be characteristic of the alkaloid strychnia. The discoverers could detect with it half a grain of strychnia in half a gallon of the pale ale (of Allsop & Son),

(*t*) This inquiry was instituted at the invitation of the English brewers of ale, who were naturally indignant at the assertion made in a lecture by M. Payen, of Paris, that strychnine was there prepared in large quantities, for the purpose, as had been ascertained by the French authorities, of being sent to England, to be there employed in the manufacture of the celebrated bitter beer of that country. *Vide* Adulterations detected in Food and Medicine A. H. Hassell, London, Longman, Green, Longman, and Roberts, 1861, p. 6

into which it had been purposely introduced. These gentlemen attest that, after analyzing a large number of samples of pale ale taken indiscriminately from the supplies of various manufacturers, *not one of the varieties of beer*, when tested with the greatest scrupulousness, gave the *slightest evidence of the presence of strychnia.*(*u*)

The following is a description of the process used by Mr. Lonsdale in a case of supposed poisoning by a grain and a half of strychnia:—(*v*)

Experiment I.—(*a*) Portions of the stomach and contents were boiled in water pretty strongly acidulated with sulphuric acid; the mixture was then filtered, and to the liquid thus obtained a quantity of carbonate of lime was added, sufficient to neutralize the acid. This was evaporated to dryness, and digested with rectified spirit; after which it was again filtered, to remove all insoluble matter. The result, a clear liquid, was then evaporated to the consistence of syrup, which had a slightly yellowish color, and, when tasted, was distinctly and persistently bitter.

(*b*) To this alcoholic extract a few drops of strong sulphuric acid were added, and then a small quantity of powdered bichromate of potassa. A purplish tint was at first observed, but it very speedily changed to a beautiful light green, which remained permanent.

(*c*) A very small quantity of the above extract was mixed with sulphuric acid and peroxide of lead, but there was no appreciable change of color.

(*d*) A similar quantity was tried with the bichromate of potassa test, with a very slight change of color, hardly appreciable. With a large quantity, the color was unmistakable.(*w*)

The most reliable test, and the one most generally adopted for the detection of strychnia, is that proposed by the Belgian chemist, M. Stas. A small quantity of acetic acid and water is digested with the suspected substance, and dissolves the alkaloid if it is present. This solution is separated from organic

(*u*) Med. Times and Gazette, May, 1852.
(*v*) Ed. Month. Journ., Feb. 1855, p. 116.
(*w*) *Vide* Experiment (*b*).

matters, if any there be, by repeated washing with water and alcohol, and by filtration, and is then rendered alkaline by potassa, which precipitates the strychnia. The latter is redissolved by means of ether, which is poured off and allowed to evaporate, leaving strychnia behind it. The alkaloid may be recognized by its crystalline form, its intense bitterness, and its reactions with the appropriate chemical tests.

The *physiological test*, proposed by Dr. Marshall Hall, consists in applying the suspected solution to the back of a young frog freshly taken from the pond. The skin should be first dried with blotting-paper. So small a quantity as the five-thousandth part of a grain of strychnia, thus applied, produced the characteristic effects of the poison.(*x*)

Aconite. (Monkshood; Wolfsbane.)

§ 627. 1st. *Effects.*—The leaves and root of *Aconitum napellus* contain one of the most extraordinary and speedy poisons known. The former have proved fatal when eaten by mistake for salad; and the latter, from its resemblance to horseradish, has given rise to many unfortunate accidents. The root is tapering, about the thickness of the finger at its upper part; its color externally is brown, internally it is white and fleshy. Its taste is bitter, but after a few minutes a remarkable numbness and tingling are perceived on the lips, tongue, and fauces. The leaves, when chewed, have the same taste, and produce the same feeling of numbness.(*y*) Dr. Isaacs has reported the case of an apothecary's clerk poisoned by the inhalation of the dust of aconite-root, which he was pulverizing. The effects of the drug were first manifested by numbness of the tongue and difficulty of swallowing, with dryness and a sense of constriction in the fauces. About an hour afterwards there was some difficulty of respiration, with diminution of the force, and frequency of the pulse, greatly dilated pupils, loss of voice and prostration of strength. Very slight convulsions occurred, at repeated intervals, for about five hours, when the patient

(*x*) Lancet, June, 1856, p. 628.

(*y*) Pereira. For several cases, *vide* Headland, Lancet, March, 1856, p. 341.

was supposed to be dying. The countenance was hippocratic, the pupils very greatly dilated, the pulse 36 and feeble, and the breathing correspondingly slow. There was also, from the first, great oppression in the cardiac region. Two weeks afterwards the aphonia still continued.(z) The pharmaceutical preparations most in use, and which, therefore, are most apt to be either accidentally or intentionally employed, are the ordinary and the saturated tinctures and the alcoholic extract. There being several formulæ for these preparations, they are variable in strength, owing to the variable quantity of aconitina contained in the prescribed dose. Thus, two persons, who took twenty-five minims of the tincture, died;(z^1) while another, who swallowed an ounce and a half of the tincture prepared according to the Parisian Code, survived. The *aconitina* prepared by Mr. Morson, of London, is so powerful that, according to Pereira, one-fiftieth of a grain has endangered life; but, on the other hand, a case is reported by Dr. Golding Bird, in which, although two grains and a half of this alkaloid were taken, the patient recovered, after having very dangerous symptoms. Pereira states, also, that there is a spurious aconitina sold in the shops, which is inert, or nearly so, since he took one grain of it without perceiving the least effect upon the tongue or otherwise.(z^2) The effect of a slight increase in the medicinal dose is well seen in the following case, communicated to Pereira by Dr. Redfern. The patient, who was suffering with acute articular rheumatism, took five drops of the tincture three times a day, for two days, without marked relief. On the third day the dose was increased to six drops, at the same intervals. Two doses of this amount were taken; and an hour after the second he was found in a state of extreme restlessness, and complaining of great pain in various parts of his body. To use his own expression, he felt as though his skin were too tight for his body. He described his sensations

(z) New York Journal of Medicine, Sept. 1859, p. 191.

(z^1) The tincture made from the root is about five times stronger than that from the fresh leaves.

(z^2) The preparations sold under the name of this alkaloid are altogether unreliable; a number of experiments were conducted by the editor with a sample which appeared to be not much stronger than the powdered root itself.

as intolerable. At this time there was much frothing at the mouth, with violent retching at intervals. The surface of the body was cold, and bathed in profuse perspiration, which ran down his face in streams. The pulse, though at first 150 in the minute, fell to between 50 and 60 in a few minutes, and was so small and compressible as scarcely to be felt at the wrist. He recovered under the use of brandy and water, and external warmth.

§ 628. 2d. *Symptoms.*—The first and most usual *symptoms* are a burning and numbness of the lips, mouth, throat, and stomach, followed by tingling in various parts of the body, loss of sensation, vertigo and dimness of vision, tremors, cramps, great prostration, sense of fulness in the throat, speechlessness, hurried respiration, and death, in a state of collapse. Vomiting and purging are also usual symptoms, but are not observed in every case. General convulsions are unusual, as we find that, in fifty-three cases collected by Dr. Tucker, of New York,(*a*) they are mentioned as having occurred only in seven. In four out of twelve more recent cases there were convulsions. The mind remains perfectly clear, there being in general neither stupor nor delirium. The latter symptom was seen in three cases of the number collected by Dr. Tucker. When applied to the eye, the preparations of aconite are said to have the effect of contracting the pupil. In seventeen out of twenty cases, however, in which the poison was swallowed, it is stated by Dr. Tucker that the opposite effect was observed. Sometimes the sight is temporarily impaired. The symptoms of poisoning by aconite usually arise within a few minutes after it has been taken; and when death takes place, it is, in the majority of cases, within three hours. The quantity of aconite, or any of its preparations, capable of producing death, is, for the reasons before given, unknown. The case related by Dr. Easton,(*b*) in which twenty-five minims of the tincture were taken, shows probably the smallest dose which has proved fatal. Another case, in which twenty-five drops proved fatal,

(*a*) For these valuable tables, *vide* New York Journal of Medicine for March, 1854.

(*b*) Glasgow Med. Journal for July, 1853.

occurred in January, 1853. A gentleman, feeling himself unwell, stepped into a drug store, and was given by a medical student, a friend of his, who was attending, this amount of the tincture, under the supposition it was the proper dose. He expired about four hours after taking it, under the symptoms of poisoning by aconite. Dr. Male, of Birmingham, it is stated, died from the effects of not more than *eighty* drops, taken in ten doses, during a period of four days, the largest quantity taken at once being *ten* drops. An excise officer in England died in consequence of tasting Fleming's tincture of aconite. He said he thought he had swallowed about a teaspoonful. He did not complain at the time, but in the course of a few hours was cold and pulseless. The remedies applied were ineffectual, and he soon expired.(*c*)

§ 629. 3d. *Post-mortem appearances.*—The few cases in which *post-mortem* examinations have been made, have revealed nothing peculiar, the most constant appearance being congestion of the vessels of the head and of the lungs. It is, of course, evident that no conclusion can be drawn from such imperfect data as these.(*d*) Of the fifty-three cases collected by Dr. Tucker, in which aconite in various forms and in all variety of poisonous does was taken, twenty-seven recovered,

(*c*) Am. Journ. Med. Sci., April, 1852, p. 553.

(*d*) In the trial of John Hendrickson, Jr., for the murder of his wife by poisoning, at Bethlehem, Albany County, New York, Dr. Swinburne, who made the post-mortem examination, inferred from the emptiness of the stomach and small intestine, the corrugation of their mucous coat, and the presence of a reddish, viscid mucus in the stomach, that *vomiting* had taken place, and that this vomiting was produced by *aconite!* Dr. Salisbury, who had charge of the chemical analysis of the organs of the deceased, testified that he tested a *small portion of the stomach and a small portion of the duodenum* for prussic acid, most of the mineral poisons, then for morphine, strychnine, "stramonine," and other poisons, none of which he discovered. He then inferred the presence of *aconitine*, from the fact that, after digesting a small portion of the stomach and duodenum in alcohol, evaporating, filtering and purifying, finally with *animal* charcoal, and then testing the filtered solution by boiling in sulphuric acid, it was "*turned to a deep port-wine red color.*" We beg leave to refer the reader for well-merited strictures upon the medical and chemical evidence given upon this trial, to the candid and able review of it by Prof. Charles A. Lee, in the American Journal of the Medical Sciences, for Oct. 1844.

and twenty-six died. In all those who recovered, emetics and external and internal stimulants were employed.

From a number of experiments performed upon animals, it would seem to us as if many of the pathological effects noticed or observed by other writers might be explained by the asphyxia caused by this agent, and especially on account of the persistent pulsation of the heart for twenty minutes after the respiratory efforts had been suspended. It was also observed that the vomiting occurred most generally when the vital powers were much reduced; and that after death, very slight, if any, signs of irritation of the internal coat of the stomach were apparent. (Ed. of third edition.)

4th. *Tests.*—The remarkable symptoms occasioned by the plant, and the discovery of a portion of that which has been taken, will generally be sufficient to explain the cause of death. The only case in which it was criminally administered is that which is related by Dr. Geoghegan, where the deceased had eaten for his dinner some greens dressed by the prisoner. The latter was convicted upon the medical and general evidence, no trace of the poison having been discovered in the body. He confessed before his execution that the powdered root of aconite had been mixed with pepper, and sprinkled over the greens.(*e*)

Stas' method (§ 555) may be employed for separating the alkaloid of aconite from organic liquids. Chloroform, however, will dissolve aconitine better than ether. The chemical tests of its presence are thus stated by Dr. Taylor: It fuses and burns with a bright yellow flame; heated in a tube it evolves first an alkaline and then an acid vapor; it is soluble in weak acids and alcohol; nitric acid dissolves it without a change of color; sulphuric acid gives it a yellowish color, and, on adding a crystal of bichromate of potassa, green oxide of chromium is set free. Iodine water gives a reddish-brown precipitate in a solution of the sulphate. Tannic acid precipitates the solution; it is precipitated whitish-yellow by chloride of gold, but not by chloride of platinum. Gallic acid, corrosive sublimate, iodide and sulphocyanide of potassium

(*e*) Dublin Journal, July, 1841.

produce no change in the solution. Dr. Headland has proposed the application of the physiological test to the detection of this poison. If $\frac{1}{20}$th of a grain be obtained it will be enough; $\frac{1}{300}$th of a grain will poison a mouse with characteristic symptoms; $\frac{1}{100}$th, a small bird; $\frac{1}{1000}$th of a grain causes tingling and numbness on top of the tongue; $\frac{1}{100}$th, dissolved in spirit and rubbed into the skin, causes loss of feeling lasting for some time.(*f*)

"There is at present no chemical reaction which, in itself, is peculiar to aconitine. By, however, the concurrent reaction of several of the reagents peculiar to the alkaloids, taken in connection with the peculiar effects upon the tongue, the nature of this alkaloid may be fully established."

"In suspected poisoning by aconite in its crude state, before proceeding to a chemical examination of the mixture presented for examination, the analyst should carefully examine for any solid portions of the plant, which, if found, may be identified by their botanical character. All parts of the plant have a bitter taste, which is soon followed by a persistent sense of numbness and tingling in the lips and tongue."(*g*)

Lobelia Inflata. (Indian Tobacco.)

§ 630. This plant, which in the hands of empirics has been productive of so much mischief, is very similar in its effects to ordinary tobacco. It is a powerful nauseating emetic. It causes severe and speedy vomiting in most cases, attended with continued and distressing nausea, sometimes purging, copious sweating, and great general relaxation, extreme prostration, anxiety, contracted pupils, insensibility, and occasionally death preceded by convulsions. As an emetic, the dose is from ten to twenty grains, as an expectorant, from one to five grains. The poisonous principle, called lobelina, a viscous, transparent oil with a strong alkaline reaction, has been obtained in a pure state by M. Bastick.(*h*) The trial of Samuel Thomson for the murder of Lovett by this drug is given in considerable detail in the chapter on "Malpractice." Other cases of death from its

(*f*) Lancet, March, 1856, p. 343.
(*g*) Wormley, Micro-Chemistry of Poisons, 1867, p. 619.
(*h*) Gaz. des Hôp., July, 1851.

given him by a greengrocer, stated that
years there had been, in England, *thirtee*
with it.(*i*) When any of these cases were
ever, the culprits usually managed to escap
was convicted and sentenced to three mont
Dr. Beck says, "that thousands of indivi
States have been murdered by the combi
and lobelia, administered by the Thomson
founder of what has been called '*Coffinis*
who styles himself, 'A. S. Coffin, M.D.,
Botany,' declares in his 'Botanical Guide
Natural Pathology of Disease,' 17th ed.,
not a poison,' 'that it never operates up
perfect health;' and he says that the pow
may be given in doses of a teaspoonful e
cup of vervain tea or pennyroyal, and re
rates as an emetic; and he adds, 'Never
give enough'!!"(*l*)

(*i*) Med. Times and Gaz., 1853, ii. 568.

(*j*) Taylor on Poisons, 2d Am. ed., p. 732.

(*k*) *Vide* Pharm. Journ., Sept. 1, 1849, and Feb

(*l*) Pereira. For cases, *vide* Med. Gaz., Aug. 1849, June, 1850, and Pharm. Journal, Aug. 1851 384. The following case of lobelia poisoning we of its brevity. "The defendant, Riley Drake, produced the death of Miss Lucina Frost, by 'the

States Dispensatory (Wood & Bache). This alkaloid is a yellowish liquid, lighter than water, of somewhat aromatic odor, and very acrid durable taste. It is soluble in water, but much

were also present at the post-mortem examination. Drs. Thomas Jackson and N. S. Davis, both residents of Binghamton, were also sworn in regard to the properties of lobelia, which they stated 'to be an active narcotico-acrid poison, when taken in large doses.'

"This closed the evidence on the part of the prosecution, when the defendant called Charles Gearnsey, Haman Gearnsey, Samuel Martin, Harry Martin, Alvah Parsons, Nathaniel Broughton, Charles Elliot, Sherlock Black, Rhodia Gearnsey, George Doolittle, Uriah Doolittle, James Russel; all of whom testified that they were personally acquainted with Riley Drake, and considered him a skilful physician of the *Thomsonian* school. The defendant then called the following *Thomsonian* and *Botanic* doctors to prove the qualities of the lobelia. Folkert Van Vleck, sworn: 'Lives in Hamilton, Mad. Co. Is a physician of the Thomsonian order. Twelve years' practice. Have had as many patients as I could attend to. Have used lobelia in almost every case of inflammation and fever, and usually with good success. In case of remittent fever, should use lobelia as an emetic, and afterwards in broken doses. My patients have always recovered. Lobelia produces an emetic effect on the healthy stomach. It will not produce inflammation under any circumstances. Did not hear the testimony of Dr. Brownson. Heard Dr. Hand's. Thinks that lobelia would not produce the effect described by Hand.' Cross-examined: 'Says he lost only one *fever patient*. Has lost some with consumption. Gives lobelia in consumption. Has been present at a post-mortem examination. Thinks that a single dose of lobelia could not be taken so as to produce death; it might be by repeating the dose. Cannot tell whether tobacco is a *poison*, or not. Thinks cicuta would produce nausea. Has never studied surgery, anatomy, etc., and does not deem it necessary.' William Rose, sworn: 'Is a botanic doctor. 'Has used lobelia for thirty years in all cases where emetics were needed. In 1825, had one hundred cases of scarlet fever, in which he used lobelia, and did not lose a patient. Has no knowledge of its possessing poisonous qualities. Understands by *narcotic* poison, that which stops the blood. Don't know how opium produces death. Thinks arsenic would produce death quicker than cicuta.' Jabez Jeffers, also a botanic physician, gave similar testimony to that of Dr. Rose. Thomas W. Griffin, sworn, says: 'He is a Thomsonian physician; has practised eighteen years as such. Says he uses three articles, viz.: lobelia, Cayenne pepper, and Barbary bark, in all cases, and in all *stages* of disease, and under all *circumstances*, and *always* with *good* effect. Thinks that lobelia is not a poison.' The testimony being closed, the case was ably argued by Lieut. Gov. Dickinson, for the defendant, and by the Hon. Joshua A. Spencer, in behalf of the people, when it was submitted to the jury by Judge Morrell. The jury, after an absence of a few hours, returned with a verdict of guilty. Judgment was, however, suspended until the next term of court."—*New York Journ. of Medicine*, Nov. 1844.

more copiously in alcohol and ether; and the latter readily removes it from its aqueous solution. It has an alkaline reaction, is soluble and forms crystallizable salts with sulphuric, nitric, and hydrochloric acid, and a very soluble but uncrystallizable salt with acetic acid. It forms an insoluble compound with tannic acid, which instantly precipitates it from its solvent. By a boiling heat it is entirely decomposed, losing all its acrimony; but when combined with acids, it may be boiled in water without undergoing a change. By experiments upon animals it seems to give the narcotic without the emetic action of the plant lobelia.(*m*)

Cedar Oil.

§ 632. The oil of the common juniper (Juniperus Virginiana) has an action upon the system similar to that of savin, except that it appears to have a more decided narcotic influence. Dr. Wait reports four cases of poisoning by this oil, two of which proved fatal. The quantity taken in each case was from half an ounce to an ounce, and in three of them it was swallowed with the view of bringing on abortion. The patients were seized with convulsions, and vomited a fluid having a strong odor of the oil. After the convulsions had subsided, they fell into a comatose condition. The *post-mortem* appearances in the two fatal cases were not very striking. There were several small red patches upon the lining membrane of the stomach, and the duodenum showed marked signs of inflammation. The uterus in each case was in a healthy, gravid state. The odor of the oil was distinctly perceived on opening the stomach.(*n*)

Savin.

§ 633. The leaves of this plant have, in the fresh state, a strong, peculiar, and heavy odor, especially when rubbed, and a nauseous, resinous, and bitter taste. The dried tops are of a

(*m*) Am. Journ. of Pharmacy, ix. p. 105, and xiii. p. 1.

Lobelia has been used in certain quack medicines as an anti-tobacco agent, to prevent by its substitution the desire for chewing. In this way some persons have suffered from the narcotic effects of this drug.

(*n*) Boston Med. and Surg. Journ., 1849.

yellowish-green color, and are less odorous than the fresh ones. The *oil of savin* is a limpid, almost colorless liquid, having the unpleasant odor of the plant, and a bitter, acrid taste. The medicinal dose is from two to six drops. But the use of the oil or of the dried leaves of this plant, in medicine, is exceedingly restricted. From the frequency, however, with which it is resorted to for the purpose of procuring abortion it is necessary to notice its effects. The oil of savin, when applied to the skin, exercises a powerful rubefacient and even vesicant action. Swallowed in large doses, it occasions vomiting, purging, and other symptoms of gastro-intestinal inflammation. Pereira says, that, according to his observation, it is the most certain and powerful emmenagogue of the whole materia medica. He quotes, from a German author, the case of a woman who swallowed an infusion of savin to occasion abortion. Violent and incessant vomiting was induced, which was followed in a few days by excruciating pain in the abdomen, abortion, dreadful hemorrhage from the uterus, and death.

Two other fatal cases are given by Dr. Christison, in one of which abortion was produced. In two others, related by Dr. Taylor, the women being respectively in the seventh and eight month of pregnancy, violent and fatal gastro-intestinal inflammation was induced, and abortion followed. In one of these cases, furnished by Mr. Letheby, the symptoms resembled those of narcotic poisoning; the woman was found lying on her back, perfectly insensible, and breathing stertorously. Although, therefore, the power of producing abortion cannot be denied to this drug, it is the result of general observation that this effect ensues only when it is taken in such doses as to endanger life by the violent inflammation set up in the stomach and intestines, and that it may even then destroy the life of a pregnant female without bringing on the premature expulsion of the child. In a case reported by Dr. Hinds, a woman five or six months advanced in pregnancy brought on premature labor by repeated doses of oil of savin. Before and after this event she suffered greatly from purging, vomiting, and intense pain, which terminated in a dan-

gerous attack of peritonitis. She was actively treated, and recoverd.(*o*)

Mitschterlich has made some experiments on animals(*p*) which show that the oil of savin is a powerful poison. It is absorbed into the system, as he determined from its peculiar odor, which he detected in the exhalations from the lungs, the cavities of the body, in the blood, and in the urine. The bloodvessels of the intestinal canal, after death from this drug, were injected, and the epithelial coat was in places thrown off; but, according to Mitschterlich, the signs of inflammation in the alimentary canal were not so great as to induce the belief that death from poisoning by the oil of savin was induced by its local action; he inclined to attribute the fatal results to the absorption of the poison itself. He noticed, also, a congestion of the kidneys and that muscular irritability (contractility) continued for a long time after death.

There is a case related by Kopp(*q*) of an infant who died from the effects of breathing an atmosphere charged with the odor of oil of savin, which had been left all night in a bottle uncorked near the cradle.

§ 634. 1st. *Post-mortem appearances.*—After death there are found, in general, undoubted evidences of inflammation of the stomach and intestines. In one of Dr. Christison's cases, the inside of the stomach was red with patches of florid extravasation, and there was extensive peritoneal inflammation, with fibrinous effusion. The contents of the stomach had a green color. In the case communicated by Dr. Salisbury to Dr. Beck (*vide* "Abortion"), where the examination was made from twelve to fourteen hours after death, the stomach was found softened and *perforated*, its contents emptied into the cavity of the abdomen, and there were signs of extensive peritonitis. The perforation was about the size of a fifty-cent piece, and was situated in the region of the greater curvature, near the cardiac orifice. For several inches around the perforation, the stomach was very much corroded, thinned, and softened, so that

(*o*) Times and Gazette, Nov. 1857, p. 524.
(*p*) Mitschterlich, ii. p. 659.
(*q*) Richter, Aüsfürlich, Arzneim, Supp. Band., p. 408.

it was easily torn. The œsophagus and upper part of the small intestines are described as inflamed. Evidence of the presence of savin in the intestinal canal was obtained, and a phial was discovered in the room, still containing half a drachm of the oil of savin and tincture of lavender. In a case occurring to Mr. Lord, of Hampstead, the œsophagus presented a dark, arborescent injection, with slight patches of ecchymosis, and in the stomach there was a large patch of redness about three inches in length; the vessels of the mucous membrane were considerably injected, forming infiltrated patches, especially about the lesser curvature, but there was no ulceration or erosion. Here, also, a large quantity of a greenish fluid was found, of the appearance and consistency of green pea soup, which was found on examination under the microscope to be due to the presence of finely triturated savin powder. The intestines, also, were highly inflamed, the duodenum being of the color of cinnabar, and there was also some peritonitis.

§ 635. 2d. *Detection.*—According to Pereira, powdered savin may, on account of its green color, be mistaken for bile, but, when mixed with distilled water, it entirely subsides, and, provided no bile be intermixed, the supernatant liquor will be devoid of a green color.

If savin have been given in the form of infusion or decoction, it may be impossible to detect it, but, when the oil has been administered, it may be separated by distillation. Furthermore, it has been already stated, savin in powder may be recognized by means of the microscope, the circular pores being visible, and the acuminated shape of the leaves. The odor, also, may aid in its recognition.

Taxus Baccata. (Yew.)

§ 636. The leaves and berries of the common yew have been known for ages as poisonous. Although Orfila gave them to animals in many cases without effect, numerous cases of accidental poisoning by them are known. It is usually classed among the acrid narcotics, although, in most cases of poisoning by it which have been reported, acrimony has appeared to be the least essential of its properties. In the case of a lunatic who died fourteen hours after chewing yew leaves, the symp-

toms were giddiness, sudden prostration of strength, vomiting, coldness of the surface, spasms, and irregular action of the heart.(q[1]) Similar effects were seen in a child who died four hours after eating the berries.(r) Brandis says, a young woman took, as an abortive, the leaves of the yew, and fell into the sleep of death without convulsions. Indeed, one might have supposed her to be really sleeping, for her cheeks preserved the hue of life, and a quiet smile played over her face.(s) In Henke's Journal,(t) an interesting history is given of the poisoning of eleven persons by a decoction of yew leaves. They had partaken of it as a prophylactic against hydrophobia, some of their dogs having been bitten by one supposed to be rabid. In half an hour all of them were seized with giddiness, confusion of sight, pain in the head, nausea and vomiting, and then fell asleep. Two of them, however, died within about an hour, without either pain or convulsions, but with a smile upon their countenance. The rest recovered without further symptoms. The *post-mortem appearances*, in these and the preceding cases, threw no light upon the manner in which the poison affected the system, except from the negative evidence of the absence of any well-marked signs of inflammation. In Mr. Hurt's case, however, it is stated that, besides patches of redness upon the mucous membrane of the stomach, it was also much softened.

Oil of Tansy.

§ 637. The few cases that have been reported of poisoning by the oil of tansy indicate that its appropriate position is among the narcotico-irritant poisons. It has been often taken for the purpose of inducing abortion, but does not seem to possess this property, which is popularly attributed to it. A fatal case of poisoning with half an ounce of this oil is recorded in the *Am. Journ. Med. Sci.* for May, 1835. Frequent and violent clonic spasms were experienced, with much disturbance of respiration. No signs of inflammation in the stomach and

(q[1]) Dr. Mullan, Dub. Hosp. Gaz., 1845.
(r) Hurt, Lancet, Dec. 10, 1836.
(s) Blumenbach's Med. Bibliothek, Bd. 3, p. 684.
(t) Erg. Heft. 43, p. 127.

bowels were found upon dissection. Death occurred in two hours after taking the poison. A young lady took a teaspoonful of the *oil* in mistake for the *essence* of tansy, for the purpose of promoting the catamenial discharge. She complained of dizziness, and became insensible in ten minutes, was seized with convulsions, and her respiration was laborious and her pulse irregular. She died in one hour and a quarter after taking the oil. Another young lady in the family took of the medicine at the same time, but vomited very soon, and suffered no inconvenience.(*u*) In a case which came under the notice of Dr. Dalton, of Lowell, recovery took place in consequence of spontaneous vomiting having occurred. Nevertheless, the girl remained insensible and convulsed for some time after it. The most interesting and detailed case is that related by Dr. Dalton, Jr., of Boston. The quantity taken was a little less than an ounce and a half, and death took place in three hours and a half. The girl, when first seen, had fallen out of bed, in convulsions, and was entirely unconscious. The cheeks were highly flushed, the eyes open and brilliant; the pupils widely dilated and insensible; the skin was warm; pulse full, rapid, and strong; respiration hurried and stertorous, and obstructed by an abundance of frothy mucus, which filled the air-passages and was blown from between the lips in respiration; the breath had a strong odor of tansy; convulsions occurred every five or ten minutes, in which the respiration was suspended, the arms raised and rigidly extended, and the fingers contracted. In the intervals between the convulsions there was no return of consciousness, and the jaws remained clinched so that it was impossible to administer any medicine by the mouth.

§ 638. The *autopsy* was made ten hours after death. The countenance was natural, the cadaveric rigidity was very strong, and there was only a slight discoloration of the dependent parts. The brain was not congested in any part, nor was there any effusion. Neither was there any appearance of congestion in the lungs. The interior of the heart exhaled a distinct odor of tansy, as did also the cut surface of the pectoral muscles. There was a strong odor of tansy in the peri-

(*u*) Am. Journ. Med. Sci., July, 1832, p. 279.

toneal cavity. "The stomach contained about twelve ounces of a semi-fluid, yellowish-gray substance, consisting of partially digested food—potato, cranberries, onions, etc.—mixed with an abundance of small, yellowish-brown, glistening oil-globules, exhaling an excessive odor of tansy; mucous membrane generaliy pale, not vascular in any part, but throughout nearly the whole of the great pouch brownish and much thinned and softened, so that for a considerable space it was nearly or quite destroyed. There was an old, whitish, slightly puckered cicatrix of the mucous membrane on the posterior wall of the stomach, near the smaller curvature, but no other morbid appearance."(*u*[1]) A four months' fœtus was found in the womb, not in the least disturbed. A two-ounce phial, containing still five drachms of theoil of tansy, was found in the pocket of the girl's dress; and a mug was also found, smelling very strong of the medicine, from which it had apparently been drunk, mixed with water.

Half an ounce of oil of tansy, taken by a pregnant female to procure abortion, produced a partial loss of consciousness, and convulsions. It failed, however, of its purpose.(*v*) No other means have as yet been proposed, or are perhaps necessary, for the detection of this oil in cases of poisoning by it, than its powerful and peculiar aromatic smell.

Cocculus Indicus.

§ 639. 1st. *Symptoms.*—This is the fruit of *Anamirta Cocculus.* The kernel, which is the only poisonous portion of the berry, has no smell, but an intensely bitter taste. It contains an alkaloid, called *picrotoxia*, which is an exceedingly active poison. It appears, from the experiments of Glover, Routh, and Falck, that the prominent symptoms produced by it in animals are salivation and tetanic convulsions, which usually terminate fatally, although the dose required to kill is much greater than that of other poisonous alkaloids, as much as forty grains of it being required to kill a dog. Cocculus indicus is chiefly used for the purpose of taking fish and of

(*u*[1]) These appearances would hardly be called morbid, but probably were due to a *post-mortem* digestion of the stomach by its own secretion.—(Ed. third ed.)

(*v*) Bost. Med. and Surg. Journ., Dec. 1857, p. 383.

sophisticating malt liquor. It is also used for the destruction of lice. Several fatal accidents have occurred in this country from it. Dr. Thompson reports one case from its *external* application. A child, aged six years, whose head, after the hair had been cut close, was washed with an alcoholic tincture of cocculus indicus, was seized, in less than half an hour after its application, with tetanic convulsions. The pupils during the spasm were exceedingly contracted, and in the interval between the attacks were dilated to the fullest extent. By touching the eyelids, the spasm could be produced at pleasure. The case was treated with energy, but the child died in a few hours. 2d. On *post-mortem* examination, no changes of any note were observed. A younger sister of the deceased, who had also been submitted to the same cleansing process, was likewise attacked in a similar manner. Under the use of counter-irritation by mustard, and injections of the tincture of assafœtida, she recovered, the convulsions gradually subsiding about three hours after the attack commenced. The next morning a scarlatinous eruption appeared upon the body and arms, which gradually faded during the day.(*w*)

§ 640. The following account of several cases of poisoning by the internal use of this substance has been kindly communicated by Dr. Fish, formerly assistant resident physician at the Philadelphia Hospital, Blockley. A strong decoction of this berry (two ounces to a pint of water) is used in that institution for the destruction of vermin upon the paupers. The vessel containing it was unfortunately placed near some tonic infusions in use by several patients. Through the ignorance of the nurse, a wineglassful of this decoction was given to each of three persons, and two tablespoonfuls to three others, in mistake for their usual medicine. Two of those who took the largest quantity were seized with convulsions about twenty minutes after they had taken the poison, and died in about half an hour. This happened in the evening, and their muscles were still contracted the next morning. Both of these men

(*w*) Philad. Med. Examiner, April, 1852, reported by William B. Thompson, Senior House Surgeon, Emigrant's Hospital, Ward's Island.

were much reduced by intemperance and disease. The remaining four, who were seized within a few moments of each other, and within half an hour after they had taken the poison, presented the following symptoms: faintness, mental confusion, giddiness, dimness of vision, nausea, excessive thirst, severe pain in the abdomen, and in one case insensibility. The pulse was much weakened, and the respiration was slow and labored. Emetics were given to them, and, after their operation, mucilaginous drinks and stimulants. They all recovered, but suffered greatly from headache during the rest of the day.

Another case is mentioned in Traill's Outlines; and one is referred to by Dr. Taylor, in which the post-mortem examination distinctly revealed traces of gastro-enteritis, due to the irritant action of the poison. In this case, however, the patient lived until the nineteenth day.

§ 641. The following case presents a curious question in the administration of poisons. The prisoner was indicted for administering poison, and it was proved that two *cocculus indicus* berries had been given to a child nine weeks old. The child, after having swallowed them, threw up one by vomiting, and the other passed through her body in the course of nature, and was found next day in her clothes.

Two medical witnesses, called on the part of the prosecution, proved that the *cocculus indicus* berry is classed with the narcotic poisons; that the poison consists in the presence of an alkaloid, which is extracted from the kernel; that all the noxious properties are in the kernel; that it has a very hard exterior or pod, to break which much force is required.

One of the witnesses added that the berry, if the pod is broken, is calculated to produce death in an adult human subject, though he did not know how many berries would be required for the purpose; that he thought the poison contained in the kernel of two berries, if the pods were burst, and if retained on the stomach, might produce death in a child nine weeks old, but that the berry could not be digested by the child, and that it would pass through its body, without the pod being burst, and so would be innocuous (as had, in fact, happened in the present case).

The counsel for the prisoner objected that the berries were not poison within the meaning of the statute, for that, though the kernel of the berries contained poison, yet the pod rendered the poison innocuous. The judge (Vaughan Williams) overruled the objection, and left the whole case to the jury. Verdict, guilty.

Judgment of death was recorded, but execution was stayed in order to submit the point raised by the prisoner's counsel to the consideration of the judges. The discussion before them in the Exchequer Chamber is given in detail by the reporter, and is quite interesting.

The counsel for the prisoner observed that the indictment was founded on the statute 1 Vict. c. 85, sect. 2, which makes it a capital felony to administer to, or cause to be taken by, any person, "any poison or other destructive thing," with intent to commit murder. The real question is, whether the berries in the state in which they were administered were "poison." The prisoner thought he was giving a destructive thing, but did not do so. It was inquired of the counsel by the judges what he would say if arsenic was given in a globule of glass? Again, if arsenic was put in a paper envelope, and that wrapped in oiled paper and administered? He contended that in "such states it could not be a destructive thing." But it was replied, if a person gives poison in too small a dose, you would say that it was not within the statute, as it could not be destructive. If you are right in so saying, persons might give doses of arsenic and speculate on the size of the dose. Finally, Chief Justice Wild remarked, "The question here is whether the prisoner administered poison with intent to murder. The kernel of the berry was a poison, but he administered it in a condition in which it was not capable of doing injury. Is that administering poison? If a person administers poison with intent to murder, but accompanies it with something which prevents its acting, we all think it is the offence provided for by this enactment, and that the conviction must be affirmed." Justice Alderson said, "This is very different from the case of a person administering an innocent thing and thinking it poison; there he does not ad-

minister poison at all; here he does." The other judges concurred in affirming the conviction.(x)

§ 642. Orfila concludes, from experiments undertaken by him,(y) that, 1st, powdered cocculus poisons dogs; 2d, it acts upon the nervous system very much like camphor, but especially attacks the brain; 3d, *picrotoxia* is the active principle of the berry.

Bonnefin(z) concludes that the convulsive action of the poison was caused indirectly by stimulation of the cerebro-spinal axis; and these effects seem analogous to the action of veratrum viride.

"The experiments of Zschudi present the following comparative results of administration of strychnine and picrotoxin, both substances being given in two-grain doses:—

Strychnine.	*Picrotoxin.*
Causes tonic spasms.	Tonic and clonic spasms alternately.
Kills in three minutes.	Kills more slowly, *i. e.*, in an hour and a half.
Does not act upon the brain.	Acts in some degree as a narcotic upon the brain.
Never causes vomiting.	Excites frequent vomiting.
Does not act upon the secretions of saliva or bile.	Increases both in a very remarkable degree."(z¹)

§ 643. *Post-mortem appearances.*—These are not sufficiently striking to be of any very great assistance in determining poisoning by this drug; though in a few cases there have been observed signs of congestion of the brain and nervous centres.

§ 644. Dr. Taylor states that "porter, ale, and beer owe their intoxicating properties in some instances to a decoction or extract of the berries of cocculus indicus."(a) For a very interesting view of this matter, reference is made to Hassall's book on "adulterations detected in food and medicine."(b) It appears that cocculus indicus is often put into malt liquors to give a false strength to them. In his testimony before the

(x) Am. Journ. Med. Sci., April, 1851, from Regina v. Clanderoy, Carrington and Kirwan's Nisi Prius Reports, vol. ii. p. 709.

(y) Toxicologie, t. ii. p. 648.

(z) Thèse pour le Doctorat en médecine, 1851.

(z¹) Stillé, Mat. Med., and Therapeutics, from Canstatt's Jahresbericht, 1848, p. 137.

(a) Med. Jurisprudence, p. 324. (b) Op. cit.

Parliamentary committee he stated that he had ground many cwts. of cocculus indicus "to go into the poor man's drink."

In England cocculus indicus can be purchased at the druggist's under the name of "*multum.*" Mr. Simonds, in his testimony before the same committee, stated, "In the suburbs of London I may mention that it is a common practice with the publicans to adulterate beer on Saturday nights."

Child,(*c*) in a work which passed through eleven editions, gives, in a receipt for porter, "a quarter of an ounce of cocculus indicus."

Morris,(*d*) in a receipt for making twenty-five quarters of malt, gives six pounds of cocculus indicus.

Not only is beer itself adulterated, but frequently the very materials from which it is made are adulterated, as, for instance, the hops and malt.

§ 645. For the detection of the active principle of cocculus indicus Mr. Herapath directs, that the beer or porter should first be treated by an excess of acetate of lead, and then filtered, and the lead should then be completely removed by sulphuretted hydrogen gas, the filtrate from which should be evaporated over a water-bath until it becomes of a syrupy consistence, and then treated with a little pure animal charcoal. After standing for some time, the charcoal is collected on a filter, washed with a very little water, and dried at a steam heat. The charcoal contains the picrotoxin, which may be obtained by boiling the charcoal in a little pure alcohol, and the solution evaporated upon glass slides. It is recognized by its forming plumose tufts of acicular crystals, or else oat-shaped forms. The solution of this alkaloid has a very bitter taste. Heated in a tube it evolves an acid vapor like digitaline; hydrochloric acid dissolves it without change of color; it is soluble in alcohol, ether, chloroform, and amylic alcohol. Sulphuric acid imparts to it an orange-yellow color, which becomes pale by dilution. Strong nitric acid dissolves it without any change of color. Tannic acid and the chloriodide of potassium and mercury do not precipitate it from its solutions. When boiled with potash and the sulphate of copper, it reduces the oxide like grape-sugar.

(*c*) On brewing porter. (*d*) Brewing malt liquors.

Mr. Langley (*e*) proposes to separate this from other poisonous alkaloids by virtue of its peculiar chemical properties; for it does not combine with acids to form salts, but readily combines with bases; for a dilute solution of potassa will dissolve one-eighth part of its weight of the alkaloid. Water thus slightly alkalized gives up readily most all the alkaloids to ether, when the latter is shaken with the solution; but if the liquid is strongly acidulated, the alkaloids remain combined with the acid, while the ether will entirely remove the picrotoxin. The ethereal solution thus obtained, when allowed to evaporate spontaneously, leaves the picrotoxin in crystals. By this process Mr. Langley obtained $\frac{1}{7\,5\,0}$th of a grain of the alkaloid from a pint of ale.

The stomach of a poisoned cat was treated with alcohol and the solution evaporated to dryness. Acidulated water was poured on the residue, and this mixture shaken with ether yielded crystals of picrotoxin, on evaporation of the ether.

Atropa Belladonna. (Deadly Nightshade.)

§ 646. The root, leaves, and fruit of this plant are all poisonous. The berries are black, and have often been eaten by children in ignorance of their poisonous properties. Dr. Taylor states that they were on one occasion openly sold in the streets of London as an edible fruit. Two persons, who had eaten of them, died; and the man who sold them was tried and convicted of manslaughter. A case graphically described by this author will suffice as an illustration of the symptoms produced. "A boy, aged 14, ate, soon after breakfast, about thirty of the berries, which he had bought in the street. In about three hours it appeared to him as if his face was swollen, his throat became hot and dry, vision impaired—objects appeared double, and they seemed to revolve and run backwards. His hands and face were flushed, and his eyelids tumid; there were occasional flashes of light before his eyes. He tried to eat, but could not swallow on account of the state of his throat. In endeavoring to walk home he stumbled and staggered; and he felt giddy whenever he attempted to raise his head. His

(*e*) Pharmaceut. Journ., 1862, p. 277.

parents thought him intoxicated; he was incoherent—frequently counted his money, and did not know the silver from the copper coin. His eyes had a fixed, brilliant, and dazzling gaze; he could neither hear nor speak plainly, and there was great thirst; he caught at imaginary objects in the air, and seemed to have lost all knowledge of distance. His fingers were in constant motion; there was headache, but neither vomiting nor purging. He attempted to get out of bed, with a reeling, drunken motion; his speech was thick and indistinct. The pupils were so strongly dilated that there was merely a ring of iris, and the eyes were insensible to light. The eyelids did not close when the hand was passed suddenly before them. He had evidently lost the power of vision, although he stared fixedly at objects as if he saw them. The nerves of common sensation were unaffected. When placed on his legs he could not stand. The pulse was 90, feeble and compressible; his mouth was in constant motion, as if he was eating something. His bladder was full of urine on admission. He continued in this state for two days, being occasionally conscious; when, by a free evacuation of the bowels, some small seeds were passed; these were examined and identified as the seeds of belladonna. The boy gradually recovered, and left the hospital on the sixth day after his admission."(*f*) Total blindness is not an unusual effect of this poison. It was observed in a child, seven years of age, found wandering in the streets of London.(*g*) Sometimes the cerebral symptoms are much more aggravated than in the above case, there being frequently delirium or stupor, which, as well as the other symptoms, is slow in passing off. In a case related in the *Lancet*, a lady was given by mistake a drachm of the extract in soap liniment; she fell into a comatose condition in half an hour; the pupils were widely dilated, the hands and feet cold, and the pulse scarcely perceptible. Her jaws were rigid, and there was no vomiting; the stomach-pump was used, and she recovered in a few days gradually. Another instance is mentioned in the Annales d'Hygiène, in which it caused serious symptoms, from having been put into soup instead of caramel. The toxical

(*f*) On Poisons, Am. ed., 617. (*g*) Lancet, Dec. 1859, p. 561.

effects of belladonna are produced when applied locally, or introduced into the rectum. A lady suffering from hypogastric pain, applied to the abdomen a liniment composed of camphorated oil and extract of belladonna. Forty-eight hours after commencing its use she was seized with delirium. The pupils became dilated, and there were irregular movements, lipothyma, redness of the face, and a fixed stare. The menses flowed abundantly, anticipating their proper epoch by ten or twelve days.(*h*) A fatal case of the employment of an enema of the decoction of the root is recorded.(*i*) The extract varies very much in strength, and is sometimes quite inert.(*i*[1])

§ 647. *Atropia* is a white, transparent, silky, crystalline powder, having no odor, but a very bitter and acrid taste. When impure it is somewhat colored and has an unpleasant smell. Its effects are similar to, but more powerful than, those of belladonna, of which it is the poisonous principle. About one-sixth of a grain is capable of producing unpleasant symptoms. It is chiefly used for dilating the pupil. A young man poisoned himself with two grains of this alkaloid. No trace of the poison could be detected in the stomach or intestines. Dr. Andrew, of the Royal Infirmary, Edinburgh, had a patient who was under the use of atropia locally, to the eye. She swallowed one morning, by mistake, between five and six drachms of the solution, containing about two-thirds of a grain of atropia. She was immediately sensible of her error, her eyesight failed her, as well as her voice, the muscles of her face were convulsively moved, and she complained of a burning heat in her throat and stomach. She was very restless, but unable to stand. Although emetics and purgatives were given to her, the next day she was violently agitated and presented the symptoms of a person with delirium tremens. She recovered, but had double vision, spectral illusions, and various disturbances of the nervous system for a week or two.(*j*)

(*h*) Times and Gaz., August, 1859, p. 173.

(*i*) Casper's Wochenschrift, Feb. 1845, p. 101.

(*i*[1]) The susceptibility of persons to this poison varies greatly. A dose which would produce little or no disturbance in one individual may cause unpleasant symptoms in another.

(*j*) Edinb. Month. Journ., Jan. 1852.

Three or four drops of a solution of atropia, containing two-thirds of a grain to the ounce of water acidulated with acetic acid, were put into the eye of a man with double cataract. In half an hour he had vertigo, and shortly after all the symptoms of poisoning with belladonna, flushed face, dilated pupils, and incessant hallucinations. His bladder became distended, and he was unable to empty it. Violent delirium continued during the night. He recovered in four days, these unpleasant symptoms having gradually disappeared.(*k*) Dr. Bethune has reported a case in which a solution of two grains of atropia to the drachm was applied three times in one morning to the eye. In the afternoon the patient was attacked with delirium, and had an uncertain gait, sleeplessness, and difficulty of swallowing. On the day but one after he had another attack of delirium, which somewhat resembled delirium tremens, as he saw imaginary persons in the room.(*l*)

§ 648. The anatomical lesions produced by belladonna and atropia are by no means characteristic. Most generally there is a marked congestion of the lungs, meningeal membranes, of the brain and of the retina; there has been observed also, in animals, hyperæmia at the base of the brain, in the choroid plexus, and in the lateral ventricles. Congestion of the retina is especially noticed after slow or repeated poisoning. In every case this state of hyperæmia is only the first degree of interstitial hemorrhage which is met with quite frequently. (Tardieu.)

The diffuse redness of the gastric mucous membrane should be ascribed to the brandy which has been used as a vehicle for the poison. (Ibid.) Rosenberger(*m*) relates a case in which the brain mass, the cerebellum, and the spinal cord were the seat of numerous capillary apoplexies.

§ 649. *Recovery of atropia from organic mixtures* is not easy. The alkaloid is more readily extracted by chloroform than by ether. The same process should be used for its discovery as for the other alkaloids.

(*k*) Am. Journ. Med. Sci. (from Gaz. des Hôpitaux), Oct. 1853, p. 540.
(*l*) Boston Med. and Surg. Journ., April, 1857, p. 201.
(*m*) Canstatt's Jahresbericht. 1845, p. 295.

From the blood.—Prof. Wormley[a] states that absorbed atropine may be recovered from the blood by acidulating the latter by sulphuric acid (one drop of acid to each ounce of the liquid), and agitating it with something more than its own bulk of alcohol. The mixture is then gently heated for about fifteen minutes, and the liquid, after cooling, should be strained through muslin and the residue washed with alcohol, and then strongly expressed. The strained liquid should be concentrated at a moderate temperature over a water-bath, again strained, then evaporated to a small volume, filtered, rendered alkaline by potash, and the liberated alkaloid extracted by chloroform. If the latter residue is not sufficiently pure, it is again extracted by chloroform.

The extract should be tested by its physiological property, of dilating the pupil of the eye of some animal, such as a dog or a cat. Herbivorous animals are not so susceptible as the carnivorous to the action of this poison.

Belladonna must be recognized by the presence of the husks and seeds, when these have been taken, in the stools. The leaves may also be known by their botanical characters.

Digitalis Purpurea. (Foxglove.)

§ 650. The leaves of this plant are the part usually employed, although the seeds contain also a large proportion of its active principle, which is called *digitalin*. The symptoms produced by digitalis in a poisonous dose have some peculiarities by which they may be distinguished from those caused by other poisons enumerated in this class. It is characterized by its remarkable property of causing slowness of the pulse. This symptom, which is quite familiar to physicians, was experimentally produced in nineteen patients in Andral's clinic, the object being to test the efficacy of the pills of digitalin recommended by Homolle and Quevenne. In all of them the pulse was reduced gradually about twenty-five beats, after the use of the pills for a period of time which varied with the individual. The effects of the poison are cumulative; it may pass a long time without any serious effect upon the system, and then

[a] Op. cit., p. 551. [illegible]

display its properties suddenly in a violent manner, and also after being discontinued, its action upon the system does not immediately cease.

The following is an example of poisoning with the tincture of digitalis, where a teaspoonful was taken in a glass of water. The symptoms did not manifest themselves until five hours after the dose had been taken; then they commenced with a feeling of nausea, which increased until violent and frequent vomiting took place. There were great præcordial distress, intense frontal headache, dimness of vision, with dilated pupil, ringing in the ears, cramp in the muscles, very powerful but at the same time irregular and intermittent pulsations of the heart, with diminished frequency (44 in the minute), the pulse strong and tense, the respiration sighing, the thirst uncontrollable, retention of urine, sleeplessness, and great debility. The next day, in addition to these symptoms, there was violent delirium, and from that time they continued very gradually to decrease for ten or eleven days. The pulse was very long in regaining its frequency.(*p*) A case is recorded by M. Caussé of a young woman who was pregnant, and who secretly took a large quantity of the expressed juice of digitalis, either to diminish the œdema of her limbs, or to produce abortion. The latter effect was produced, and death followed in twelve days, probably as much from the want of medical care as from either the abortion or poison.(*q*) The tincture is often quite inert, or very feeble in medicinal properties; most of the fatal cases of poisoning by digitalis which have occurred have been either from the leaves in substance or infusion, or from digitalin. A decoction of the leaves, prescribed by a quack in London, to the amount of six ounces, proved fatal in twenty-two hours. Dr. Leroux relates a case of poisoning by digitalin which nearly proved fatal.(*r*) The dose taken amounted to 0.03 gramme, which is equal to about half a grain. In another instance, in which 40 granules, equal to about two-thirds of a grain, were supposed to have been taken, the patient recovered

(*p*) Union Médicale, No. 112. 1851.
(*q*) Bull. de Thérap., lvi. 101.
(*r*) Union Médicale, No. 99. 1852.

under the use of emetics and stimulants.(*s*) The symptoms, however, were not as urgent as in the preceding case. In still another case which recovered, the dose of digitalin taken was also 40 granules, but the symptoms were somewhat different from those enumerated above. Within an hour the person, who was a female, states that she was seized with dizziness, debility, vomiting, and cold sweats, was unable to feel her pulse beat, or to pass her urine; she lay incapable of moving or speaking, her eyes felt strained, and actually projected considerably; she had hallucinations, also continual nausea, extreme tenderness of the epigastrium, and great thirst; and the pulse fell to 46 in the minute.(*t*)

§ 651. *Digitalin* occurs in pale straw-colored scales, or in a white powder, and is so extremely bitter, as to communicate this quality to 200,000 parts of water. Its taste is most strongly perceived in the fauces, and it has a peculiar and faintly aromatic smell. It is soluble in alcohol, is neutral in its chemical relations, combines neither with acids nor bases, and is unchanged by exposure to the air. Its maximum medicinal dose is stated at one-sixteenth of a grain.

§ 652. The *morbid alterations*, in one case where these have been reported, were merely an injection of the "external membranes of the brain, and some redness of the mucous membrane of the stomach." It need hardly be said that this evidence amounts to nothing. In M. Caussé's case, the mucous membrane of the stomach near the lesser curvature of the pyloric orifice was covered with purplish patches. This was the only lesion referable to the action of the poison. Two cats, accidentally shut up in a room where this plant had been spread out to dry, were found the next morning dead. They had eaten of the leaves. Their bodies were very much relaxed, and, it is stated, putrefied very soon.(*u*)

(*s*) Dr. Ghereau, Union Méd., Jan. 10, 1854. Quoted in Ed. Monthly Journ. for August, 1854.

(*t*) Annuaire de Thérap., 1858, p. 102.

(*u*) Archiv. für Pharmacie, Oct. 1858, p. 16.

Quinia.

§ 653. The occasional occurrence of alarming and even fatal effects from the use of sulphate of quinia renders it necessary that we should briefly notice them. When given in larger doses than usual, continued for too great a length of time, or in persons peculiarly susceptible to its influence, it produces considerable cerebral disturbance, and may occasion severe headache, vertigo, deafness, diminution or loss of sight and of speech, delirium, coma, and great prostration.(*v*) Dr. M'Lean relates four instances in which complete blindness was produced, from which, however, the patients partially recovered in the course of a year. In one of these cases, three drachms were given in the course of 36 hours; in another, an ounce; in the others the quantity was somewhat less, being in one three drachms and a half in three days, and in the other the quantity is merely said to have been "large."(*w*) In the same journal will be found the paper of Dr. Baldwin detailing his experiments upon animals, and giving the particulars of a case which came under his notice, where he considered that death resulted from the use of quinia, although not administered in large doses. Death was preceded by extreme restlessness, dilatation of the pupils, blindness, and convulsions. The disease was intermittent fever. Without presuming to deny the accuracy of Dr. B.'s opinion of the cause of death in this case, we may state that we have seen precisely the same alarming cerebral symptoms in a child seven years of age, with intermittent fever, which could not have been caused by quinia, as none had been taken in any form. A man with acute rheumatism, under the care of M. Récamier at the Hôtel Dieu, after taking about 100 grains of the sulphate of quinia in hourly doses of from four to five grains, was suddenly attacked with delirium and died in a few hours. A similar case occurred under M. Husson's care, but the patient recovered. The whole quantity given was 93 grains, the symptoms coming on after the last dose.(*x*) Four cases are collected by

(*v*) Wood and Bache. (*w*) Am. Journ. Med. Sci., April, 1847, 515.
(*x*) Gaz. des Hôp., Dec. 1842.

M. Mélier in which it is said that this drug was fatal to life;(*y*) and Guersant has given an account of a physician who died poisoned by sulphate of quinia, after taking nearly five ounces of it in the course of eight or nine days.(*z*) In this, as in other similar cases, sight and hearing were lost, the limbs were cold, the breathing slow and labored, and the pulse feeble, irregular, and infrequent. Death took place by coma preceded by delirium.

§ 654. *Daphne mezereum.*—The berries of this plant, which resemble those of the red currant, are actively poisonous. In two cases reported by Dr. Schwebes, the symptoms were nausea and vomiting, followed by complete narcotism; there were convulsive movements of the eyes and upper extremities occurring at short intervals, the pupils were contracted and scarcely sensible to the stimulus of light. The children were restored by cold affusion to the head and other appropriate treatment.(*a*) Dr. Christison mentions the case of a child, aged eight years, which proved fatal, and three others which recovered. The symptoms were similar to those described.

Hydrate of Chloral.

§ 655. This is a chemical compound discovered by Liebig, in 1831, and introduced in the year 1869 by Prof. Oscar Liebreich, as a therapeutic agent. It is not proposed to discuss here its physiological or therapeutical action.(*b*) This

(*y*) Mém. de l'Acad. de Méd., x. 733.

(*z*) Dict. de Méd., 2ème éd., xxvi. 569.

(*a*) Casper's Wochenschrift, No. 35. 1848.

(*b*) Reference may be made to Das Chloral-hydrat; also Action du Chloral sur l'Economie, Revue Thérapeutique, 1st Oct. 1869; and Allg. Med. Central Zeitung, Jan. 1870, by O. Liebreich; and Demarquay, Comptes Rendus de l'Académie des Sciences, t. lxix. p. 968; translated in Boston Med. and Surg. Journ. Nov. 1869, p. 253. Jacquemet, le Choral et ses Vicissitudes Experimentales, Montpellier Médical, 1869, t. xxiii. pp 450 et 554. Laborde, Dangers de l'Administration du Chloral, Comptes Rendus de l'Academie des Sciences, t. lxix. p. 987. Personne, Sur la Preparation et les Propriétes de l'Hydrate de Chloral, Repertoire de Pharmacie, 1870, p. 241. Dr. B. W. Richardson, Report on Hydrate of Chloral, Med. Times and Gazette, London, Sept. 1869, p. 290. A Review of Liebreich's Pamphlet, in London Practitioner, 1869, p. 239. Gazette Hebdomadaire, Liebreich, 1871, p. 715; also some experiments reported in N. Y. Med. Journ. for June, 1872, by editor.

agent has in a few instances been unfortunately the cause of death when taken in an overdose. There have been also cases reported where it was used with suicidal but none with criminal intent. Our notice will therefore be confined to a review of the cases which have been noticed in the various medical journals.

Dr. Smith, of Baltimore,(*c*) reports four cases which came under his personal observation; in some of these fatal cases of poisoning, chloral-hydrate had been used in moderate continued doses, and in the others in an excessive single dose. Dr. Smith calls especial attention to a rash and cutaneous desquamation that occurred in these cases.

§ 656. Dr. Richardson, of London,(*d*) considers two drachms of chloral a dangerous and three drachms a fatal dose. He thinks also that we cannot safely increase the daily dose (in fact it is in this way that most of the accidents have occurred) of chloral as we can that of opium, and that the system does not become habituated by its continued use nor able to eliminate larger doses than at first.

A clergyman in England(*e*) had been in the habit of using chloral in small doses to induce sleep. Though the precise dose that preceded his death could not be ascertained, yet during ten days he had consumed from fourteen to fifteen drachms (nearly two ounces). At the autopsy the peculiarity noticed was a congestion of the cerebral membranes while the brain mass was pale and friable; there was no very great increase of blood in the smaller vessels except in the choroid plexus.

In the first half of the volume for 1871 of the *Lond. Med. Times and Gazette*, are recorded three more cases of death occurring after the use of this drug.

Dr. H. W. Fuller(*f*) reports a case in which thirty grains (half a drachm) of chloral produced alarming symptoms, and another in which the same dose produced death.

(*c*) Boston Med. and Surg. Journ., July, 1871, p. 33.
(*d*) Med. Press and Circular, Feb. 25, 1871.
(*e*) Brit. Med. Journ., Feb. 25, 1871.
(*f*) London Lancet, March 27, 1871.

Dr. Needham(*g*) reports the case of a woman, aged fifty years, who took thirty grains of chloral to relieve a mental unquietness, amounting to insanity. The first day she took this dose at half past five in the evening and repeated it at eleven o'clock. The second day at ten in the morning she took fifteen grains, and at three in the afternoon she repeated this dose. The third day she took thirty grains at one o'clock in the morning, again a few moments after eight, and finally at half past one in the afternoon. On the evening of the second day she was out of bed and moving about. On the third day she was sleeping and had a somewhat rapid pulse, and at six in the evening she was still sleeping. The next morning her pulse was 108, and attempts to arouse her were of no avail. The pupils were a little contracted. After several ineffectual attempts to arouse her during the day, one-tenth of a grain of strychnine (an antidote recommended by Prof. Liebreich) was subcutaneously injected in three separate doses; but she passed from her lethargic sleep into a state of coma, and died the next day at four in the afternoon.

At the autopsy an examination was made only of the brain, which was found everywhere deeply congested, and in the meshes of the pia mater was a sero-gelatinous exudation.

Dr. Dabb reports in minute detail(*h*) a case where serious apprehension was felt for the life of his patient.

Another case has been reported in the service of Dr. Ludlow(*i*) at the Philadelphia Hospital, where a nurse, supposed to have swallowed four hundred and sixty grains (an ounce and a half), was found in an unconscious condition, from which she was with great difficulty rescued by vigorous flagellation of the surface of the body and by the application of electricity.

From what is known with regard to the use of this drug it is probable that not more than thirty grains of chloral should be administered in a single dose, and that it is somewhat dangerous to repeat this at shorter intervals than six to eight hours. (The absorption of chloral by a fasting stomach is quite rapid.)

(*g*) The Medical Times, Feb. 15, 1871.
(*h*) Med. Times and Gaz., Oct. 8, 1870.
(*i*) The Medical Times, Oct. 15, 1870.

§ 657. The first symptom of danger, after the continue *abuse* of this drug, is a peculiar rash resembling in some pa ticulars that of scarlatina or roseola. This may be followe by desquamation of the cuticle, and is generally, perhaps inv riably, accompanied by albuminuria.

The dangerous symptom that follows a single overdose c chloral is profound sleep, accompanied with stertorous breath ing, not very unlike that produced by opium; but still th patient can be partially aroused though unable to talk c herently; this profound sleep may pass into coma, muscula relaxation, and finally death.

Strychnine is not to be relied upon(*j*) as an antidote t chloral poisoning. The most theoretical and practical metho of relief in case of poisoning would be external stimulatio rectal injections of some stimulating liquid, as a mixture c castor oil or broth with turpentine, and the use of electricity either in the form of galvanization or faradization; and al the placing of the patient in a warm atmosphere, and causin him to inhale warm air.

"The maximum quantity of chloral-hydrate that can b borne, at one dose, bears some proportion to the weight of th animal subjected to its influence. The rule, however, does n extend equally to animals of any and every class. The propo tion is practically the same in the same classes, but there is r actual universality of rule. * * * The human subjec weighing from one hundred and twenty to one hundred an forty pounds, will be made by ninety grains to pass into a de sleep, and by one hundred and forty grains into fatal slee * * * Evidence has been brought before me which lea me to think that, although eighty grains would in most i stances prove fatal, it could, under very favorable circumstanc be recovered from.

"Dr. Hills, of the Thorpe Asylum, Norwich, has, for e ample, favored me with the facts of an instance in which suicidal woman took no less than *four hundred and seventy-t grains* of the hydrate of chloral dissolved in sixteen ounces

(*j*) *Vide* Gaz. Hebdomadaire de Méd. et de Chirurgie, June 21, 1872, 409; and July, 1872, p. 457.

water, and actually did not die for thirty-three hours. Such a fact, ably observed as it was, is startling; but it does not, I think, militate against the rule that one hundred and forty grains is the maximum quantity that should, under any circumstances, be administered to the human subject. * * * As a near approximation to the truth, an adult person who has taken chloral in sufficient quantity to be influenced by it disposes of it at the rate of about seven grains per hour. In repeated doses the hydrate of chloral might be given at the rate of twelve grains every two hours for twenty-four hours, with less danger than would occur from giving twelve times twelve (144) grains at once; but I do not think that amount ought to be exceeded, except in the extremest circumstances, even in divided doses."

The above is extracted from an exceedingly interesting and probably reliable report on the physiological action of organic chemical compounds, by B. W. Richardson, M.D., F.R.S.(*k*) From other experiments and observations alluded to in the same paper, Dr. Richardson "has no doubt it will be found, as the chronicle of deaths from chloral hydrate increases, that the mortality of the agent will be greatest when the thermometrical readings are the lowest, and *vice versâ*."

§ 658. *Chemical properties of chloral.*—This compound presents the appearance of a clear and transparent liquid, which gives to paper the appearance of grease spots, which, however, soon disappear on exposure to the air. Its density at 18° C. (64.4° F.) is 1.502. It boils at 94° C. (201° F.) and distils without undergoing alteration. The density of its vapor is about 5.0.

Its odor is penetrating, provoking tears. It has almost no taste. In its anhydrous condition it is very caustic, especially if the skin is exposed to its vapor at a boiling point. It dissolves easily in water in great quantity and without residue. If a few drops of this body be dropped into water, an immediate precipitate is formed at the bottom of the vessel, under the form of an oleaginous liquid, but by a slight elevation of

(*k*) Report of the British Association for the Advancement of Science, for 1871, p. 145.

temperature these drops are immediately redissolved. The liquid possesses no acid reaction. If nitrate of silver be added no precipitate of chloride of silver is formed. When even a concentrated solution of chloral in water is boiled with red oxide of mercury no change takes place.

If instead of gently heating chloral with water, it is put in contact with a few drops of water, it will immediately combine on agitation, attended with the production of heat. A few moments after a white crystalline mass appears. These crystals placed in contact with water are dissolved without residue. This solution contains hydrate of chloral (or chloral-hydrate), which has undergone no alteration.

Chloral dissolves iodine, bromine, phosphorus, and sulphur, and their easy solution is attended with heat. Iodine communicates to it a rich purple color. The metallic oxides (anhydrous) produce no action upon chloral. The latter can be distilled over oxide of copper, magnesia, or mercury, without undergoing any alteration.

It acts in the same way with lime, baryta, and the anhydrous strontias. In distilling chloral with these last-named oxides, that liquid should be in excess; for, heated only to the boiling point of water in the vapor of chloral, these oxides immediately decompose that substance. By making the vapor of chloral pass over anhydrous and heated lime or baryta, these bases become incandescent; there is disengaged also oxide of carbon, and there may be formed a metallic chloride impregnated with a light carbon. Sometimes it happens, that, in rectifying chloral upon baryta or lime, at the moment that the liquid does not cover the residue, the whole mass becomes heated to a red heat, and remains a long while in a state of incandescence; in such an instance, a considerable quantity of chloride of barium or of calcium mixed with a brown matter is obtained. A colored oily precipitate passes over which is not chloral.

The vapor of chloral, passing over iron or copper heated to redness, will be changed into metallic chloride. These metals become thus coated with a brilliant porous charcoal.

§ 659. Chloral-hydrate acts differently from the anhydrous chloral; in this form or in aqueous solution, the alkaline

oxides decompose chloral with great facility, and with evolution of heat. The result of this decomposition is chloroform and a formiate in solution, with also a small amount of a chloride from the destruction of a portion of the chloroform. Nitric acid (even boiling) has no action upon chloral-hydrate. The latter can also be boiled in a vapor of chlorine or be exposed to the sunlight in a flask filled with chlorine without suffering alteration. It may be slightly tinged with yellow in contact with chlorine from the absorption of a little of this gas.

§ 660. As there has been no chemical process reported by which chloral-hydrate can be recovered from the tissues of the body, it would be worse than useless to give one at this time, but it would by no means be difficult to devise a means by which this agent could be recovered in a case of poisoning, and then its production in court should be demanded.

The following method based on Stas's method for the detection of alkaloids is suggested:—

Take the heart, liver, lungs, or similar organs, and cut them into fine shreds, moistened with acidified alcohol (double their weight of strong alcohol, to which is added five centigrammes of tartaric or oxalic acid), press and dissolve all the soluble portions; collect the fluids thus obtained, and filter.

Concentrate the alcoholic fluid at a temperature not exceeding 35° C. (95° F.), and, if no insoluble matter separate, continue to evaporate nearly to dryness. If fatty or other insoluble matters separate during concentration, pass the concentrated solution through a moistened filter, and evaporate the filtrate to dryness at a temperature not exceeding 94° C. (210° F.).

Add to the mixture four or five times its volume of pure ether, and shake; then allow it to stand until a little of the ether has evaporated spontaneously in a watch-glass; add a few drops of water, and examine for crystals of chloral-hydrate by means of a microscope. If these crystals (acicular) are found, mix the ethereal fluid with some dilute sulphuric acid (one part of acid to five of water), until the well-shaken fluid manifests acid reaction; allow the mixture to stand at rest, decant the supernatant ether, and treat the mixture with ether

in the same way, and then place the ethereal mixture over sulphuric acid *in vacuo*, and add a little water to produce the crystals of hydrate of chloral.

Veratrum Album and Veratrum Viride.

§ 661. Both these drugs, known as white and green hellebore, are exceedingly active poisons, and belong, from their peculiar characteristics, to the class of poisons called by M. Tardieu hyposthenisant. M. Oulmont,(*l*) in his observations on man and animals, found that, although the general sedative action of veratrum *viride* was the same as that of veratrum *album*, it differs essentially from the latter in the following points:—

It never has so intense an action on the digestive canal, nor produces inflammation of its mucous membrane, and the vomiting is not so severe or lasting.

The poisonous dose of green hellebore is much larger than that of the white hellebore, and the action of the former is not so quickly manifested.

§ 662. *White hellebore.*—The active principle of this drug is veratria, and the symptoms of poisoning most commonly noted are, a sense of burning heat in the stomach, with a feeling of constriction and heat in the mouth and throat, great anxiety, nausea, violent purging, vomiting, tenesmus, intestinal pain, great prostration, diminution and feebleness of the pulse and respiratory movements, muscular tremors, dilatation of pupils, depression of temperature, coldness of the extremities, convulsions, and insensibility.

Some instances are recorded in which purging was absent, and again, others, in which there was no vomiting. As hellebore is frequently used in the so-called worm powders, not a few cases of poisoning may occur from an overdose ignorantly administered or taken. A number of fatal cases of poisoning with this agent have been reported.(*m*)

§ 663. *Green hellebore.*—The symptoms of poisoning caused

(*l*) Bull. Gén. de Thérapeutique, etc., t. lxxiv. p. 145, May 30, 1869.

(*m*) Beiträge zur Gerichtl. Arzn., iv. 47; Taylor on Poisons, London, 1859, p. 575; Gaz. Hebd., vol. viii. No. 31; British Pharmaceutical Journal and Trans., Feb. 1868.

by this drug are not unlike those produced by white hellebore. The distinctions noticed by Oulmont have already been related. A few fatal cases of poisoning by this drug, called also *Indian poke*, have been reported.(*n*) M. Oulmont mentions instances of poisoning by this agent where a persistent attack of hiccough was induced.(*o*) An active principle called veratroida has been isolated from this drug. This alkaloid is soluble in ether, but a resinous principle called viridia, which is insoluble in ether, has also some of the peculiar properties of veratrum viride. The name veratroida was given because this alkaloid resembles that from the white hellebore known as veratria. It has also been asserted that viridia was not unlike the resin of white hellebore, called by Simon, *gervina*.(*p*)

The most striking difference between these two *hellebore* consists, from experiments by Oulmont on animals, in the great irritation of the alimentary canal by veratrum album, which also causes not only vomiting and purging, but a positive inflammation which may even produce death; the veratrum viride, on the contrary, may cause vomiting, diarrhœa, and even fatal prostration, without showing *post-mortem* any signs of inflammation in the alimentary canal.

The strength of the tincture of both these poisons is variable, as well as that of the different alkaloids and resinoids; hence, it is not easy to state a maximum therapeutic or a minimum toxical dose.

§ 664. Veratria and the other alkaloids may be separated from organic mixtures in the same manner as the other vegetable alkaloids previously mentioned. The chloroform residue may be examined by sulphuric acid in the following way. If it contains much foreign matter the residue may be dissolved in acidulated water, and then potassa may be added to neutralize the excess of the acid, and the alkaloid redissolved by

(*n*) Am. Journ. of Med. Sciences, July, 1865; Am. Journ. of Pharmacy, Sept. 1865.

(*o*) Bull. Gén. de Thér., lxxv. p. 526.

(*p*) *Vide* an article by Dr. E. Peugnet in the Medical Record, N. Y., May 1, 1872; also articles by Wm. Bullock, Am. Journ. of Pharm., Sept. 1865, March, 1866, and in Am. Journ. of Med. Sciences, Jan. 1870, by H. C. Wood, M.D.

chloroform. The extract has an exceedingly acrid taste, followed by a persistent sense of dryness in the fauces, but has no bitter taste. The impure alkaloid is more apt than the pure alkaloid to cause an attack of sneezing when placed in contact with the mucous membrane of the nose. "If a small quantity of *pure* veratine be touched with a drop or two of cold concentrated *sulphuric acid*, it assumes a yellow color, then a reddish tint, and slowly dissolves to a pinkish solution, which after several minutes acquires a deep crimson-red color. These changes are brought about almost immediately by the application of heat. This is one of the most characteristic reactions of veratria known (see *post.*)"(*q*)

"Concentrated hydrochloric acid dissolves the pure alkaloid without change of color; but, if the solution be heated to the boiling temperature, it quickly acquires a red color, which ultimately becomes very intense and resembles that of a solution of permanganate of potash. Under this reaction, if only a drop of the acid be employed, almost the least visible quantity of the alkaloid will manifest itself."(*r*)

§ 665. M. Prévost (*s*) contrasts the effects of this alkaloid upon the muscular system of frogs, in a way which may serve to test the presence of this poison as distinct from that of strychnia.(*t*)

The differential effects are as follows:—

In Strychnia Poisoning.	*In Veratria Poisoning.*
1. Convulsions occur at the commencement.	1. Spasmodic contractions occur at the commencement.
2. The initial convulsion is succeeded by a series of convulsions.	2. The initial convulsion is prolonged, and usually terminates in a series of faint fibrillary twitches.
3. Extremely slight peripheral excitation causes a convulsion.	3. It is difficult to originate spasmodic contractions by excitation of the periphery.
4. The most feeble peripheral excitation always originates general convulsions.	4. Excitation often causes contractions that are altogether limited to the excited portions; occasionally, however, the contractions are general.

(*q*) Wormley, op. cit., p. 649, and p. 657. (*r*) Ibid.

(*s*) Récherche Expérimental relative à l'Action de la Veratrine.

(*t*) It may be well to state here that many of the alkaloids can be recognized from their effects upon the smaller animals.

In Strychnia Poisoning.	*In Veratria Poisoning.*
5. Convulsions disappear on destruction of the spinal cord.	5. Spasmodic contractions may be caused even after destruction of the spinal cord by irritation of either the nerves or the muscles.
6. Convulsions cease in limbs separated from the trunk, and consequently from the spinal cord. In parts so separated, excitation of nerve-trunks or of muscles causes merely normal contractions.	6. In limbs separated from the trunk, and consequently from the spinal cord, spasmodic contractions may be caused by irritation of the nerve-trunks or of the muscles.
7. Convulsions occur in limbs separated from the circulation by ligature of the bloodvessels, provided the nerve-trunks are intact.	7. No spasmodic contractions occur in limbs separated from the circulation by ligature of the bloodvessels.

CHAPTER XI.

POISONOUS GASES.

Carbonic acid.
Effects, § 666.
Cause of death generally accidental, § 668.
Coal-gas contains a blood-poison, § 670.
Not poisonous if pure, § 671.
Explanation of effects, § 672.
Physical character, § 673.
Carburetted hydrogen (lighting-gas), § 675.
Sulphuretted hydrogen, § 676.
Nitrous oxide.
Explanation of effects, § 678.

I. *Carbonic Acid Gas.*

§ 666. 1st. *Effects.*—This gas in itself is irrespirable; the irritation produced by it upon the glottis being so great that it closes, and respiration becomes impossible. When, however, it is mixed with the air, it may be respired, and then produces symptoms somewhat similar to those of asphyxia, but which, nevertheless, are due to its specific narcotic action upon the system through the mucous membrane of the lungs. Under the present head we include cases of poisoning by charcoal fumes,

which, however, contain, besides carbonic acid, carbonic oxide and traces of carburetted hydrogen. The first symptoms produced by this gas are heaviness of the head, a sensation of weight or pressure upon the temples, ringing in the ears, and a disposition to sleep. Then nausea and sometimes vomiting follow; the respiration becomes slower, difficult, and sometimes stertorous; the pulsations of the heart, which are at first precipitate, then become irregular, and finally slower; the muscles are paralyzed, and the individual falls into a comatose condition, which may last several hours before life is extinct. Occasionally, secondary phenomena, such as nasal or pulmonary hemorrhage and pneumonia, are observed. Still more serious consequences may result, as in the case of a man whose attempt to destroy himself with charcoal fumes was interrupted after he became insensible. An inflammation of the sciatic nerve occurred, followed by general paralysis, delirium, and death.(a) The general appearance of the body varies in different cases, according to the rapidity of death and the length of time elapsing before it is seen. Sometimes the face is red and swollen, the eyes bright and glistening, the limbs flexible, and there are red spots in various parts of the body; in others, on the contrary, there may be remarkable pallor, and a tetanic stiffness of all the muscles.

§ 667. The body has sometimes an appearance of complete repose in natural sleep; but sometimes, also, the features are swollen, discolored, and distorted. The internal appearances are a vivid red, or sometimes a violet color of the blood, or, again, this fluid may be black and thick; the soft solids are everywhere of a brighter color than natural; the lungs are voluminous, and of a brownish-black color on their exterior, and red internally; the body retains its heat and flexibility for a considerable time, and putrefaction occurs more slowly than after other modes of death.(b) The presence of carbonic acid in the air of a room where persons have died or been more or less affected by it, may be detected by the white precipitate formed by it with lime-water or a solution of subace-

(a) Arch. Gén., 5ème. sér. ix. 476.
(b) Briand, Méd. Lég., p. 414.

tate of lead. The *proportion* in which it exists may be detected, as recommended by Dr. Taylor, by introducing into a measured quantity, in a graduated tube over mercury, a strong solution of caustic potash. The degree of absorption will indicate the proportion of carbonic acid present.(*c*)

§ 668. Death from the inhalation of carbonic acid gas is almost always, where it is not suicidal, produced accidentally. There can be no doubt, however, but that a person may be thus destroyed by criminal design when asleep, this gas being of so insidious and oppressive a nature, that the individual may pass readily, without waking, from natural sleep into a state of fatal coma. Attendant circumstances may awaken a suspicion of wilful poisoning, but there is evidently nothing in the medical aspect of the case by which death can be attributed to the action of another rather than to that of the individual himself. The study of the effects of carbonic acid upon the system, under the various circumstances where it is inhaled, is important only as enabling us to refute unjust suspicions of other violent causes of death, and especially of poisoning by other agents. Such suspicions are very apt to be entertained. Dr. Christison relates a case, in which a man and woman who had survived the effects of the gas generated from a pan of burning coals in their apartment, while at the same time four other persons in the room perished, were imprisoned on suspicion of having conspired to murder their companions. Similar cases have frequently been the subject of examination before the coroner's inquest.

§ 669. Carbonic acid is disengaged not only during the combustion of fuel, but may be present in deleterious quantity in the atmosphere from other sources. Thus it has been the cause of death by the non-renewal of the air where a large number of persons are confined in a close apartment, and are obliged to respire the same air repeatedly; it is disengaged in breweries during the process of fermentation, and in greenhouses, from the plants, during the night; persons have been frequently destroyed by it who, for the sake of warmth, have laid themselves down near the vents of lime kilns; and it is

(*c*) Med. Journ., p. 529.

well known that it accumulates in the shafts of coal mines, and has there been the cause of death to large numbers of persons. The only one of these cases that can well become the subject of medico-legal inquiry is that in which death results from the gases evolved by the combustion of fuel. We use the word *gases* since, as already remarked, it is by no means certain that the fatal effects are always due to the disengagement of carbonic acid gas. Carbonic oxide, which is also evolved, is still more rapidly poisonous than carbonic acid gas.(*d*)

§ 670. Recent investigations (1872) have pretty conclusively shown that death from the inhalation of coal gases is due to carbonic oxide, which latter forms, with a certain portion of the blood, a combined salt, that will prevent the blood from absorbing oxygen; whereas the inhalation of carbonic acid gas causes death by preventing the elimination of the same gas, and also by depriving the system of oxygen. This latter gas does not form a chemical compound with the portion of blood alluded to (viz., the hæmoglobine).

§ 671. M. Demarquay(*e*) states from his own observation and experiments, if carbonic acid is injected into the veins, taking care not to inject with such force as by entering the cavities of the heart to cause death by mechanical distension of that organ, it is absorbed in large quantity and quickly eliminated. Introduced into the system by the lungs, carbonic acid produces none of the toxical properties so commonly attributed to it. In fact the mammalia can breathe a long time, without any serious inconvenience, atmospheric air or oxygen one-fourth or one-fifth of whose volume consists of carbonic acid; in man a slight disturbance may be caused after the lapse of a time varying with the susceptibility of

(*d*) M. Chevalier, in the October number of the Ann. d'Hyg. for 1854, has related a case of poisoning by the vapors of carbon. He shows that three or four per cent. of carbonic oxide will suffice to destroy a strong dog, that would not have been killed by less than thirty or forty per cent. of carbonic acid in the air. Warm-blooded animals may be destroyed by one per cent. of carbonic oxide.

(*e*) Essai de Pneumatologie Médicale; Recherches, etc., sur les Gas, Paris, 1866, p. 458.

individuals, but lasting long enough to cause the development of certain therapeutical effects which have indicated the use of the agent. Finally, the lesions after death caused by the inhalation of this gas, whether in man or animals, do not in the least resemble those caused by a toxical agent, carbonic oxide, with which it has often been confounded.

Most of the accidents caused by coal gas, confined air, vapors from vats, laying aside all account of carbonic acid, should be in a large measure attributed either to carbonic oxide, sulphuretted hydrogen, alcoholic fumes, or even to other gases, as yet little known, which have their origin from these sources.

§ 672. Carbonic acid is simply irrespirable. It is, however, unlike nitrogen or hydrogen in this respect, and yet is not more poisonous than these two gases. Respiration essentially consists in the interchange of gases between the blood and air, and, from the fact that this interchange cannot take place, according to the physical law of gases, it may be seen that the inspiration of pure carbonic acid is a material obstacle to the respiratory process, and consequently produces asphyxia. On the other hand, as hydrogen and nitrogen cannot supply the deficiency of oxygen and cause the normal changes in the blood necessary to support life, this does not result from the same physical law of diffusion of gases, they being of a different nature from the eliminated gases; yet this interchange can go on only for a limited period, and thus disturbances may be caused that are inconsistent with life.

On the continent of Europe, and especially in Paris, self-destruction by the vapors of charcoal is one of the most common forms of suicide. In England and the United States, this agent is seldom resorted to, while accidental death from the gases escaping from burning coal or the smothered combustion of wood is very frequent.

§ 673. *Qualities.*—Carbonic acid gas,(*f*) when not heated, is

(*f*) It should be observed, by the use of this term in this and previous editions is probably meant a mixture of certain poisonous vapors that are formed either from the decomposition of animal substances or that result from the combustion of coal, charcoal, and other kindred matters; it has been considered unnecessary in the revision of the previous editions to use exact technical language of science as at present known, and to correct lan-

heavier than common air, and will therefore be found in greatest quantity near the floor after combustion has ceased; but during combustion, or while the air is still warm, it will be equally diffused through the apartment. Dr. Taylor found, by experiment, that, in burning a quantity of charcoal actively in an open brazier raised above the floor, in a large apartment, the proportion of carbonic acid was nearly equal in air taken a foot above and a foot below the level of the source of combustion, there being no current to affect the results. The inferences which he draws from this and from other considerations are—1st. That in a small and close apartment individuals are equally liable to be suffocated at all levels, from the very equal and rapid diffusion of carbonic acid gas during combustion. 2d. That in a large apartment, unless the gas be very rapidly diffused by a current of air, the air around the source of combustion may become impregnated with a poisonous proportion while that at a distance might still be capable of supporting life, because carbonic acid requires time for its perfect and equable diffusion in a very large space.(*g*)

§ 674. The following case may serve to show the circuitous route by which carbonic acid may find its way into bedrooms:(*h*) A man and his wife were found dead in their bedroom; the first in an easy bent position on his right side, on the floor; the latter in a similar position, and her countenance wore a mild and placid expression. No marks of violence were found upon the bodies, and with the exception of slight suggillations on the man's back, the skin was perfectly natural in color and appearance. A *post-mortem* examination and a chemical analysis were made without any indication of poisoning being detected. There was a singular and intolerable smell in the house, strongest in the chamber. It was found, upon further inquiry and examination, that a straw mattress

guage commonly in use among non-professional as well as even among professional men; presuming that confusion of words might render the work less comprehensible, and defeat rather than further the cause of justice.

(*g*) Med. Jur., p. 585.

(*h*) An account of two cases of poisoning with carbonic acid, in remarkable circumstances, communicated by Jos. Law, Esq., Surgeon, etc., Ed. Month Journ., March, 1858.

had been burnt in the cesspool of an adjoining yard, a few days previously, the embers of which were still in a state of ignition, and, when stirred, gave off dense volumes of smoke and a disgusting smell resembling that in the house. The walls of this cesspool and of the foundation of the house were of loose stones, and under the influence of a strong west wind the products of combustion had found their way through the foundation into the boarded walls of the house, and thence into the chamber. No sulphuretted hydrogen could be detected in the gas which still escaped into the room, but sufficient carbonic acid to fatally contaminate its atmosphere. Briand enumerates several instances in which carbonic acid, coming from fires lit in an apartment other than that occupied by the deceased, has nevertheless penetrated into it and been the cause of fatal accidents.(*i*) In one of these cases a man and his wife were found dead in bed, suffocated by gas produced by the charred woodwork in the neighborhood of a fire in a room at the opposite end of a long corridor on the same floor. The gas had worked its way under the floor until it found a vent in a crack of the flooring in their apartment. In other instances the gas was driven through stove-pipes, and from one chimney-flue to another on different floors.

§ 675. *Lighting-gas.*—The ordinary illuminating gas, which consists chiefly of light carburetted hydrogen, contains also vapors of volatile liquid, carburets of hydrogen, carbonic oxide, and other elements. Light carburetted hydrogen is in itself hardly poisonous, but the composite gas, which is now everywhere so freely used for burning, has frequently caused fatal accidents. Still, the atmosphere may be very offensively loaded with it, and yet be breathed for a short time with impunity. It does not appear to act merely as an asphyxiating agent, but rather like a narcotic. The first symptoms are nausea, headache, noises in the ears, and great prostration. All of these become aggravated; the breathing then becomes oppressed, the limbs are paralyzed, and death is preceded by coma and convulsions.

The *post-mortem appearances* are, generally, intense cerebral

(*i*) Méd. Lég., p. 418.

and spinal congestion, redness of the bronchial mucous mer brane and of the lungs, and a dark color of the blood. I the fatal cases which occurred at Strasburg, and which a reported by M. Tourdes, the bronchial tubes were filled al with a white, thick, and viscid froth, streaked with blood.(

The following case is reported by Gärtner, of Stuttgard.(The gas affected a lady, her servant maid, and also an Engli pointer dog. The lady was first seized; her illness beg with an affection of the head, sickness, vomiting, and pur ing of thin rice-water-like stools, in which whitish flakes we observed. After twelve hours she recovered, but felt ve drowsy. On the fifth day she experienced pain in the bac part of the head, lassitude, vertigo, tinnitus aurium and lo of appetite, accompanied by a loaded tongue, a small pulse 90, and cessation of the menses. Blood of rather a dir dark-red color, presenting no buffy coat, was abstracted fro a vein. Next day the patient was worse; she was quite i sensible, and lay with closed eyelids; the eyes were turned u the pupils were much contracted, and unaffected by the ligh the face was not swollen; there was trismus; the arms we flexed at the elbow-joints; the respiratory movements we very feeble; the pulse was hardly perceptible; and the sk warm, but insensible to the touch. She was, however, restor by venesection and other remedies.

In the servant girl similar symptoms occurred, but not wi much severity, which may be attributed to the fact that t atmosphere of her chamber had not been so strongly impre nated with the gas. She had severe cramps of the extremiti great jactitation of the hands, flexion of the arms at t elbows, great restlessness, and inclination to yawn. Her blo presented no buffy coat. Latterly she had a non-febrile bloo diarrhœa. She recovered in fourteen days from the date her seizure.

The dog was found insensible and quite stiff, as if dead, b it soon recovered.

(*j*) Ann. d'Hyg., t. iii. p. 457. *Vide* also Devergie, Méd. Lég., t. iii. 72 and 75.

(*k*) Ed. Month. Journ., Oct. 1854.

A man employed to clean a covered passage for water, into which a gas-pipe had leaked several days before, was sickened by the smell of the air, and fell with his head under the water. In about five minutes he was with difficulty dragged out, by means of a noose round his neck. He was pale and breathed feebly, but gradually his warmth and pulse became natural; the breathing, however, was oppressed and gutteral, and the muscles of the trunk and limbs spasmodically contracted. Death took place in about seven hours. The body, which was examined thirty-five hours afterwards, was rigid, and everywhere seemed congested with blood. It exhaled a strong aliaceous odor, and the stomach and intestines were distended with a gas which took fire and burned when flame was applied to it.(*l*)

II. *Sulphuretted Hydrogen Gas.*

§ 676. This is the principal deleterious gas, which is evolved from privy wells, and from foul drains and sewers. Its familiar and extremely offensive odor affords such unmistakable evidence of its presence, that unless a person is obliged to inhale it, or is exposed to it in a concentrated form, accidents will rarely occur from it. The consideration of its effects, and the means of obviating them, is evidently more the subject of medical police or hygiene, than of legal medicine. A few observations may not, however, be misplaced. When not existing in a very large proportion in the atmosphere, it may be breathed for a certain time with comparative impunity, giving rise merely to lassitude, loss of appetite, and sometimes a typhoid febrile condition. Again, when inhaled in a greater quantity, the symptoms are acute and oppressive pain in the head and pit of the stomach; and for this reason, this gas has received from the French the name of "*plomb des fosses.*" If after experiencing these sensations the individual does not immediately withdraw from his position, he loses his consciousness, and falls, completely deprived of sensibility and the power of motion; a reddish froth runs from the mouth, the body is cold, and the face livid; the eyes are dull, and the

(*l*) Annuaire de Thérap., 1857, p. 288.

pupils dilated and immovable; the pulse very irregular, and almost imperceptible; convulsions ensue, and the person dies comatose.

In a case reported by Dr. Radcliff, of Baltimore, a man who descended into a privy-sink nearly eighty feet deep, already almost emptied by machinery, was overcome by the gases and fell to the bottom, where he remained for two hours before he could be extricated. Meanwhile cold water was repeatedly thrown upon him. Fifteen minutes afterwards he was much asphyxiated and depressed, with hurried and difficult respiration, but he recovered rapidly.(*m*)

§ 677. The *post-mortem appearances* usually described are the following: A proneness to rapid putrefaction; an offensive odor from all parts of the body; the blood dark and liquid; the right side of the heart congested, and the muscles of the body of a dark color, and insusceptible to the stimulus of galvanism.

This is not the only noxious gas evolved from privies and drains, but it is that which is the most destructive to life. There are also ammoniacal emanations, which are extremely irritating to the respiratory mucous membrane; and nitrogen gas, which sometimes accumulates in enormous quantity, but which, although irrespirable, is perhaps not positively noxious.(*n*)

III. *Nitrous Oxide Gas.*

§ 678. This gas, more properly named protoxide of nitrogen, has been lately (1872) used very extensively by dentists and somewhat by surgeons for minor operations. It deserves but little mention here. Its action is due most probably to the property which it possesses of supplying the place of a portion of the oxygen in the blood with an innocuous respirable gas incapable of supporting life, but not directly interfering with the elimination of carbonic acid gas. If pure, and properly administered, this gas can do no harm unless the inhalation be prolonged beyond the period that respiratory movements

(*m*) Am. Journ. Med. Sci., Oct. 1858, p. 377.
(*n*) *Vide* Brand, Méd. Lég.

are manifested; even then the removal of the inhaler may be immediately followed by inspiration of air, which soon takes its proper place in the lungs and blood, producing the normal changes necessary to the support of life. In this respect it resembles ether, which may also cause asphyxia, if administered by an inexperienced person.

In summer, or if kept in a heated atmosphere, the gas appears to undergo some change or decomposition; but this has been observed after a three months' heated term, in a laboratory exposed to the full effect of the sun's rays. The gas was kept over rain water in a zinc gasometer. It was supposed that the change in the character of the gas was due to the decomposition of the water over which it had been kept, as the water in another tank in the same laboratory had also undergone decomposition, and had a very repulsive odor. If in making the gas too great heat be used, deutoxide of nitrogen may be formed in the retort holding the nitrate of ammonia (the substance most commonly used in the manufacture of the gas). Yet this is quite soluble in water, through which the gas is generally, and should always be, conducted before passing into the gasometer. The present plan of condensing nitrous oxide and confining the condensed gas in an iron chamber avoids the risk which might occur from the decomposition or fouling of the water when kept in gasometers.

There has been as yet (1872) no reliable record of death immediately caused by the use of this anæsthetic gas.(*o*)

(*o*) For further particulars with regard to this gas, reference may be made to Dental Cosmos, Jan. 1869; Med. Gaz., N. Y. (extract from the London Lancet), Dec. 11th, 1869; Gazette Hebdomadaire, Paris, Dec. 10th, 1869; Dict. Enc. des Sciences Médicales, t. vii. pp. 690, 691; Boston Med. and Surg. Journal, N. S., vol. v. p. 91; Edinburgh Med. Journ., Jan. 1871; N. Y. Med. Journ., Aug. 1870; Am. Journ. of the Med. Sci., July, 1870, p. 61.

CHAPTER XII.

METHOD OF ANALYSIS OF GASES.(p)

Method of gas analysis.
Preliminary experiment, § 679.
On collecting gases, § 680.
Analysis of gases, § 681.

§ 679. BEFORE proceeding to an analysis of gases which ma have caused accidents, a tentative experiment should be unde taken in the laboratory upon portions of the gases collect from the vault, mine, cellar, or chamber in which charcoal h been burnt. It must be remembered that the draughts ar currents of air in these places prevent uniformity in the gas which may be collected, and consequently a large number experiments should be performed upon these gases, whi should be gathered as often as possible, and the average resu determined. The best method for collecting these gases co sists in emptying mercury from a bottle previously and cor pletely filled into the chamber or other place of investigatio the air then takes the place of the mercury, and the bottle ma then be carefully corked. If a large amount of gas is require fine sand, water, oil, or a saturated solution of sulphate magnesia may be used instead of the mercury. A still bett plan would be to collect these gases in a receiver or lo tube from which the gaseous contents have previously be exhausted in an air pump; the tubes can be sealed up over Bunsen gas-lamp, and then by breaking their ends the entran of the gases may be effected.

§ 680. If it is desired to collect gases from mines or caver situated deep below the surface of the earth, into which would be dangerous to enter, the same means may be used above indicated, varied in the following manner: with the a of ropes a vessel, filled with one of the liquids above mention

(p) Briand et Claudé, Paris, 1869, p. 696.

and plunged into another vessel containing the same liquid, may be lowered to the point at which it may be desired to collect the gas, and the former withdrawn from the outer vessel causes the fluid to be replaced by the gas; and when this has been accomplished, the vessel is allowed again to fall into the other vessel, and both drawn up to the surface of the earth. The most convenient method consists in having an aspirator arranged on the same principle as a chemist's wash-bottle, that is having a cork into which one straight and another bent glass tube are fixed; the former tube should go almost to the bottom of the bottle, while the latter only goes through the cork; to the former a rubber tubing is tightly adjusted, and by means of a Bunsen water pump or by suction applied in some other way the gas may be received into the bottle into which has been placed some substance capable of combining with some of the gases, such as potassa to combine with carbonic acid gas, acetate of lead in solution to combine with sulphuretted hydrogen, etc.

§ 681. The air being collected, its analysis should be conducted in the laboratory according to the usual methods. Ordinarily, it is sufficient to determine whether the normal proportion of oxygen is present, and if there is in addition to this gas also nitrogen or carbonic acid. For this purpose a certain volume of the gas is measured in a graduated tube to which is added one or two cubic centimetres of dissolved potassa, and the tube is then shaken; the diminution of volume indicates the quantity of carbonic acid; then is introduced into the same tube a small amount of pyrogallic acid wrapped up in paper; by agitation the oxygen is very rapidly absorbed, and the liquid becomes colored a deep-red tint; the second diminution of volume indicates the proportion of oxygen; the rest may be considered nitrogen. If the air has been collected from a privy-vault, it should also contain sulphuretted hydrogen; in this case, it would be necessary to commence the analysis by introducing into the tube a crystal of acetate of lead that has been saturated with acetic acid; the sulphuretted hydrogen is absorbed, and it is after this has been accomplished that potassa should be added if the analysis is to be continued as before. Phosphorus, cold or warm, may

be used to absorb oxygen; but pyrogallic acid is more serviceable for analyses of this nature.

The presence of carbonic oxide is difficult to determine, if it exists in small proportion. If a sufficient quantity is present it can be absorbed by chloride of copper. After the carbonic acid has been withdrawn from the gaseous mixture, the gas can be heated with oxide of copper fused with litharge, this giving indirectly the proportion of carbonic oxide contained in the gas.

In these volumetric analyses of gases it may be convenient to introduce the reagents into the graduated tube by means of a *papier-maché* ball made in the following way: macerate some bibulous paper in water, compress this in a bullet mould and allow it to dry into a hard ball, which may be soaked in the reagent which it is desired to employ.

CHAPTER XIII.

ON PRELIMINARY FORMALITIES IN A JUDICIAL EXAMINATION.

§ 682. When a chemist is called to give an opinion in a judicial investigation, there are certain formalities with which it is necessary he should be familiar.

1st. He may assist at the exhumation of the corpse; in such a case he must carry with him clean glass vessels, sealing-wax, a seal, and other materials with which he may securely fasten the vessels. He should also have with him a physician whose duty it should be to make the *post-mortem* examination of the organs.

2d. The stomach and intestines should be placed in a clean wide-mouthed glass bottle; in another, the liver, lungs, etc.; the brain mass in certain cases should also be put aside. If the bladder contains urine, this should likewise be put into a bottle, as many poisons are eliminated from the body with the urine, and it is by the latter that albuminuria, glucosuria, morbus Brightii, etc., can be determined.

3d. All these vessels should be tightly closed, tied, sealed, signed by the witnesses present, numbered, and labelled.

4th. If the body has been a long time buried, and in a somewhat advanced state of putrefaction, it may happen that a saponaceous mass is observed adherent to the sides of the coffin; it may also happen that the latter is even destroyed and the corpse besoiled. Under such conditions, the organs should be very carefully removed, and that portion of the earth in juxtaposition with the corpse, as well as the clothes, should be laid aside for examination; the earth of the cemetery above and around the coffin should likewise be saved.

5th. The expert should also be required to make search in the house of the person suspected of being poisoned voluntarily, by accident, or with criminal intent. His attention should also be arrested by any objects that might throw any light upon the investigation; as, for instance, should he find in the victim's room any medicaments, powders, or bottles containing liquids, he should carry these away for analysis. The vomited matters, if there are any, should also be carefully collected, as well as the cloths or towels which might be soiled; and if these have fallen on the floor, and are soaked up by the wood, carpet, or any article of furniture, all these latter should be removed and submitted to analysis. It must, however, be remembered that oftentimes criminals have arranged all these details of their crime to mislead those having charge of the investigation.

6th. The first duty of the expert is to verify the seals, labels, etc., and to notice if they have been tampered with. Afterwards, he should open the vessels and lay aside a portion of each for counter-experiments. He should take written notes of every particular, and examine every peculiarity he may notice. No detail, however insignificant at first thought it may appear, should be omitted. The odor of the suspected matters, sometimes increased by gentle heat, may indicate some trace of the poison. Thus, the presence of chlorine, laudanum, prussic acid, etc., is often betrayed by the odor. If these peculiarities are wanting, he should take a small portion of the substance, add some distilled water, and then some acidulated water, separate the liquid portion by filtration, and

then examine with reagents, such as the alkalies, sulphuretted hydrogen, etc. This is sometimes sufficient to establish the class of poison to which the victim has been subjected; yet this may require a very great skill in chemical analysis, and it is important to recover a sufficiently large amount of the toxical substance.

§ 683. 7th. If these preliminary investigations are fruitless, the stomach should be spread on a piece of clean glass or porcelain, and every peculiarity noted by a magnifying lens, as well as by the naked eye. The foreign matters should be carefully separated, and also the undigested food, which should be examined by themselves. The state of preservation of the different organs should be noted, as there are certain antiseptic poisons that prevent, and others that promote, putrefaction.

8th. In the examination of different matters, such processes as cause little or no alteration of the substance should first be employed; investigation for the organic matters should require the first attention, and that for the mineral substances be postponed.

9th. The substance may be acid, alkaline, or neutral. The presence of an acid is indicated when blue litmus paper is changed to red, and when effervescence is caused by the addition of bicarbonates; in this case, water may be added, the soluble and insoluble matters separated by filtration, and the former tested by the addition of nitrate of silver, chloride of barium, or other reagents. Nitrate of silver may be reduced by an acid liquid, if phosphorous acid is present, and, in this case, search must be made for phosphorus. The precipitates caused by the baryta salts do not always indicate a free (uncombined with a base) acid; the liquid should be submitted to distillation at a temperature below 120° C. (248° F.); if a red vapor appears, this is caused by nitric acid, an investigation of the distillate should be undertaken for the recovery of this acid; if the residue is blackened at the same time that sulphurous acid is set free, sulphuric acid may be recognized. Into the condensed liquid nitrate of silver may be placed; hydrochloric and prussic acid would be thrown down in the form of a white precipitate, and then search should be made for one or both of these bodies. Finally, the residue in the retort should be

treated by alcohol, and to the filtered solution a salt of lime be added to indicate the presence of oxalic acid, and an ammoniacal solution to indicate the presence of tartaric acid.

10th. As soon as an acid has been recognized, an investigation should be undertaken to determine the peculiar character of this acid by all known reagents.

11th. Potassa, soda, or ammonia may cause the alkaline appearance of the suspected matters. The latter may arise from decomposition; this can be driven away by boiling, and after this has been continued a good while, it may be noticed whether the alkalinity persists; in this case search is made for soda or potassa. It should be observed that the hypochlorites are alkaline, but decolorize the vegetable colors when water acidulated by acetic acid is added.

12th. If the suspected matters are neutral, they should be submitted to dialysis. The liquid outside of the porous jar or other dialyzer should be tested, and, if with a negative result, still the portions inside will undergo no alteration. Search may be made for chloroform by the process before described (§ 593), and, if no precipitate appears in the nitrate of silver solution, the process of Stas for the recovery of the alkaloids may be instituted.

13th. A portion of the substance is placed in the apparatus of Mischterlich (§ 390) with the addition of a little sulphuric acid; if the phosphorescent lumination is perceived, or if the distilled liquid reduces nitrate of silver, the presence of phosphorus may be indicated. If, instead of reducing nitrate of silver, the distilled liquid throws down a white precipitate, this precipitate should be examined for cyanogen, which may indicate that the suspected matter contains prussic acid or a cyanide.

14th. If none of the above methods have determined the presence of any known substance, the residuary portions of the different analyses are collected, and the organic matter destroyed by sulphuric acid, or by chlorate of potassa and hydrochloric acid, or by direct incineration or carbonization. The charred matters are then digested in acids, and their solutions are submitted to the different methods before described in detail; one portion introduced into Marsh's apparatus, another

precipitated by sulphuretted hydrogen, or collected on blades of metal, etc.

15th. Finally, if no poison has even then been discovered, a fresh portion of the suspected substances should be treated by concentrated alcohol, evaporated, and the residuary extract be tested by physiological experiments.

16th. After the conclusion of his investigations, the expert should remit, by a sealed package, with his report, in their natural state, the substances upon with he has not operated.

Exhalations from the Dead.

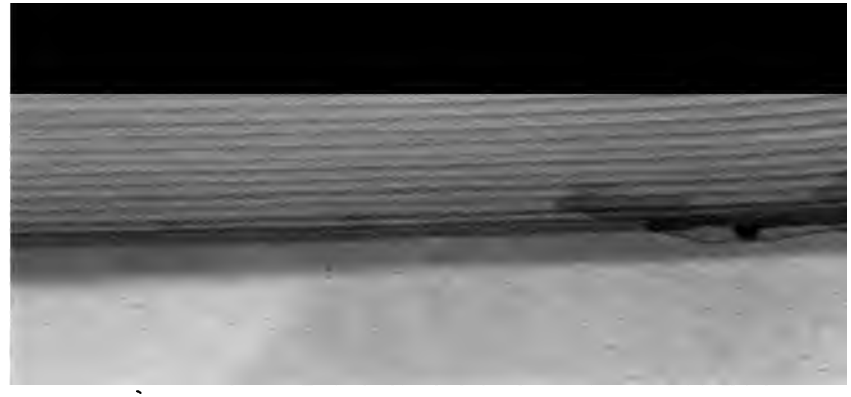
§ 684. According to the testimony of Mr. Waller Lewis,(q) the noxious character of the air which is found in the vaults of graveyards is chiefly due to the presence of carbonic acid. He says that he has never succeeded in obtaining any traces of the presence of cyanogen, hydrocyanic acid, sulphuretted, phosphuretted, or carburetted hydrogen gases, even in the smallest quantity. In the vaults under St. Mary-le-Strand he found a very minute proportion of sulphuretted hydrogen. He says, also: "I examined gases formed by bodies of persons of all ages, from the stillborn infant to those who had survived to the age of ninety-two; the coffins had been in the vaults various lengths of time; those that had been there a week were examined as well as those that had remained there a century and a half. Death had been caused by accident, by age, by disease. The latter had been of the most various kinds — typhus, phthisis, smallpox, childbirth, dropsy, and cholera. Not one of the above circumstances seemed to influence in the slightest degree the composition or character of the gases. These were most remarkably similar in every instance. All the gases I analyzed, or otherwise examined, were composed of nitrogen and carbonic acid gas mixed with atmospheric air, and holding decomposing animal matter in suspension. There was but one ingredient that was sometimes present and occasionally entirely absent; this was ammoniacal gas, which was sometimes present in very large quantities. When this was added to the other gases, it overcame all other odor;

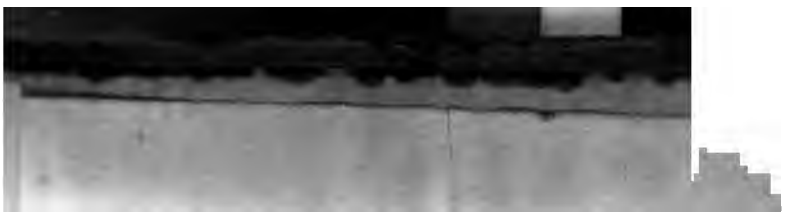
(q) Lancet, 1851.

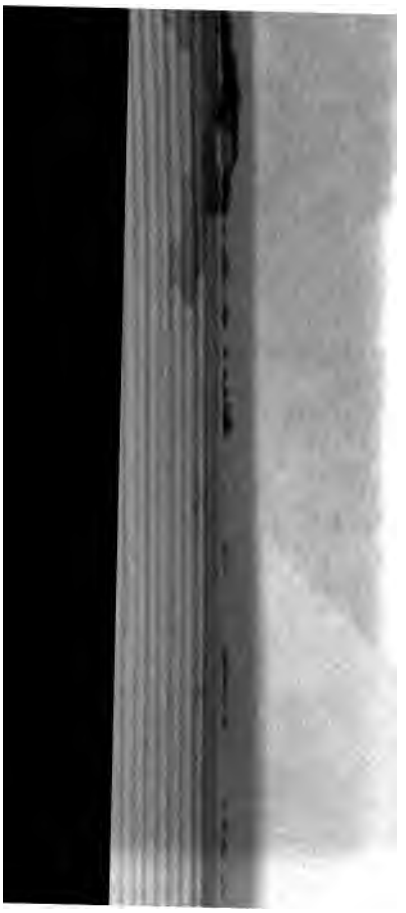
when it was absent, the smell much resembled that of very putrid moist cheese. In every instance I searched most carefully for the presence of the hydrogenous gases mentioned, but never found the slightest trace of any of them." The same results were obtained by Pellieux, in Paris, who examined all the cemeteries around that capital.(r) A lighted candle, let down into one of the vaults which stood open for twenty-four hours, and was twenty feet deep, was extinguished at the depth of five feet. Pellieux endeavored to descend into it, together with the inspector, but could not remain longer than a few seconds. A grave-digger, accustomed for many years to assist in placing coffins in the vault, was obliged to descend twice before he could succeed in emptying a bladder of water and refilling it with the gas. The symptoms exhibited by those who endeavored to descend below the point at which the light was extinguished were, first, great oppression of breathing, a feeling of weight and pressure upon the temples and eyelids, succeeded by dryness of the fauces, a peculiar hot and repulsive sweetish taste in the mouth, singing in the ears, and profuse perspiration. The countenance acquired a reddish hue, and the nose, cheeks, and lips became livid. They were obliged to return rapidly to the air to escape total asphyxia. The natural color soon returned, but severe headache continued for some time. Mr. Lewis says that in him the most prominent among the symptoms, after exposure to the putrefactive gases, were nausea and vomiting, succeeded by diarrhœa, and a throbbing pain in the upper part of the head, great prostration, and entire loss of appetite, accompanied with an unpleasant earthy taste in the mouth. He also says that these symptoms, after being experienced for a long time, were followed by a series of boils and phlegmonous erysipelas. In one instance, a sexton, who preceded him with a candle in the vault under the church of St. Andrew, Holborn, was scarcely able to save himself from sudden death by carbonic acid. The candle went out, and the man, after much exertion, presented himself in a most pitiable condition—his eyes half starting from their orbits, breathing deeply, and evidently much oppressed.

(r) Henke's Zeitsch., 1851, p. 459.

It is hardly necessary to observe that in medico-legal examinations of bodies in a state of putrefaction the physician should guard himself, by the use of chloride of zinc, charcoal, and other disinfecting agents, against inhaling the noxious gases.







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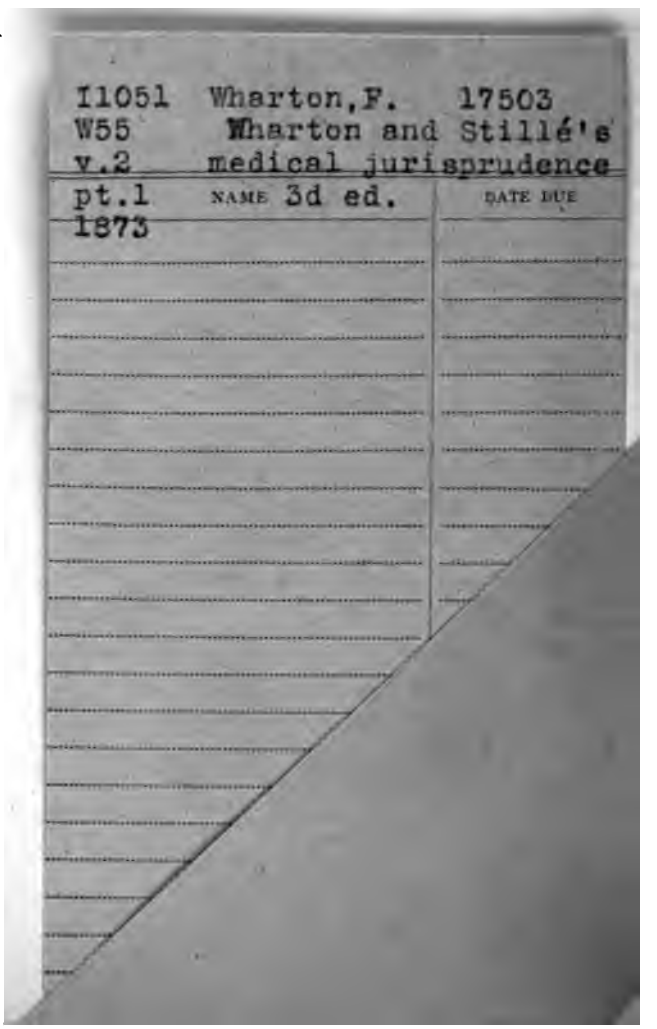
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